

# Mites of the subfamily Parasitinae (Mesostigmata: Parasitidae) in the British Isles

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## Synopsis

The mites of the subfamily Parasitinae in the British Isles and the Channel Islands are revised. Thirty-six species belonging to nine genera are recorded of which one is new to science and fourteen are new to the British fauna. Habitat and distributional data are given and keys to the genera and species for deutonymphs, males and females are provided. The taxonomy includes eleven new specific synonyms and five new combinations.

## Introduction

The Parasitidae are among the most common and widely distributed mites of the suborder Gamasina to be found in litter and humus, and certain species are especially abundant in accumulations of organic material such as rotting seaweed, compost, dung and in the subterranean nests of small mammals. Others are associated with bumblebees and burying-beetles during part of their life-cycle (the *nympha coleoprata* stage), the 'host' being used as a

means of transport. They are essentially predatory and feed upon other microarthropods, including their eggs, and on nematodes, and are rivalled in size and abundance by two other gamasine families, the Macrochelidae and the Veigaiidae.

With the exception of the work by Bhattacharyya (1963) on *Pergamasus* s. lat., there has been no revision of the remaining genera and species of British Parasitidae since that of Hull (1918), although additional species records and changes in nomenclature are documented by Turk (1944, 1945, 1953) and Turk & Turk (1952)—a quarter of a century ago. It is appropriate to mention here the unpublished thesis of Colombo (1961) in which valuable contributions are made on the developmental stages of those species associated with bees of the genus *Bombus*. On the continent of Europe, however, we have the works of Schweizer (1961) and Karg (1971), in which revisions are made for Switzerland and Germany respectively, whilst Micherdzinski (1969) has attempted a revision of the entire family based on fresh material from Poland, Germany, Czechoslovakia, China and Kashmir, together with a detailed study of past literature. More recently Bregetova *et al.* (1977) have produced a large work on the soil-inhabiting Mesostigmata. Their coverage, however, is more in the order of an amalgamation of keys from existing works.

The classification followed in the present work is that proposed by Evans and Till (1979) in which nine genera are recognized.

During the preparation of the present work the opportunity has been taken, where possible, to check on the identity of material constituting earlier British records. Also, as far as possible, papers recording the occurrence of parasitines in the British Isles have been referred to, although it is certain that some, especially general ecological and invertebrate papers, have been missed. Indeed, I should be pleased to learn of such records and to receive material to confirm identifications. The record of *Parasitus neglectus* (Berlese, 1904a) by Turk & Turk (1952) has not been verified as the specimen cannot at present be found (Dr F. A. Turk *in litt.*). Similarly with the senior author's citation (Turk, 1953) of *P. hortivagus* (Berlese, 1904a). *Parasitus wasmanni* Oudemans, 1902b, also recorded by Turk (1953), has been transferred to *Pergamasus* (Bhattacharyya, 1963, Micherdzinski, 1969, Karg, 1971).

The records quoted for distribution abroad are assumed to be referable to the species in question, but where they have already been diagnosed as otherwise this is noted. Also, the overseas distribution given for each species is not claimed to be complete as papers of an applied nature are not always widely circulated.

## Material

This revision is based on the examination of over ten thousand specimens from the following sources:

(a) The named material already curated into the collections of the British Museum (Natural History), some of it being specimens identified by A. S. Hirst during the first quarter of this century.

(b) Approximately one thousand Berlese-funnel extractions (from a total of just over two thousand) collected mainly in recent years and housed in the Arachnida Section, BM(NH).

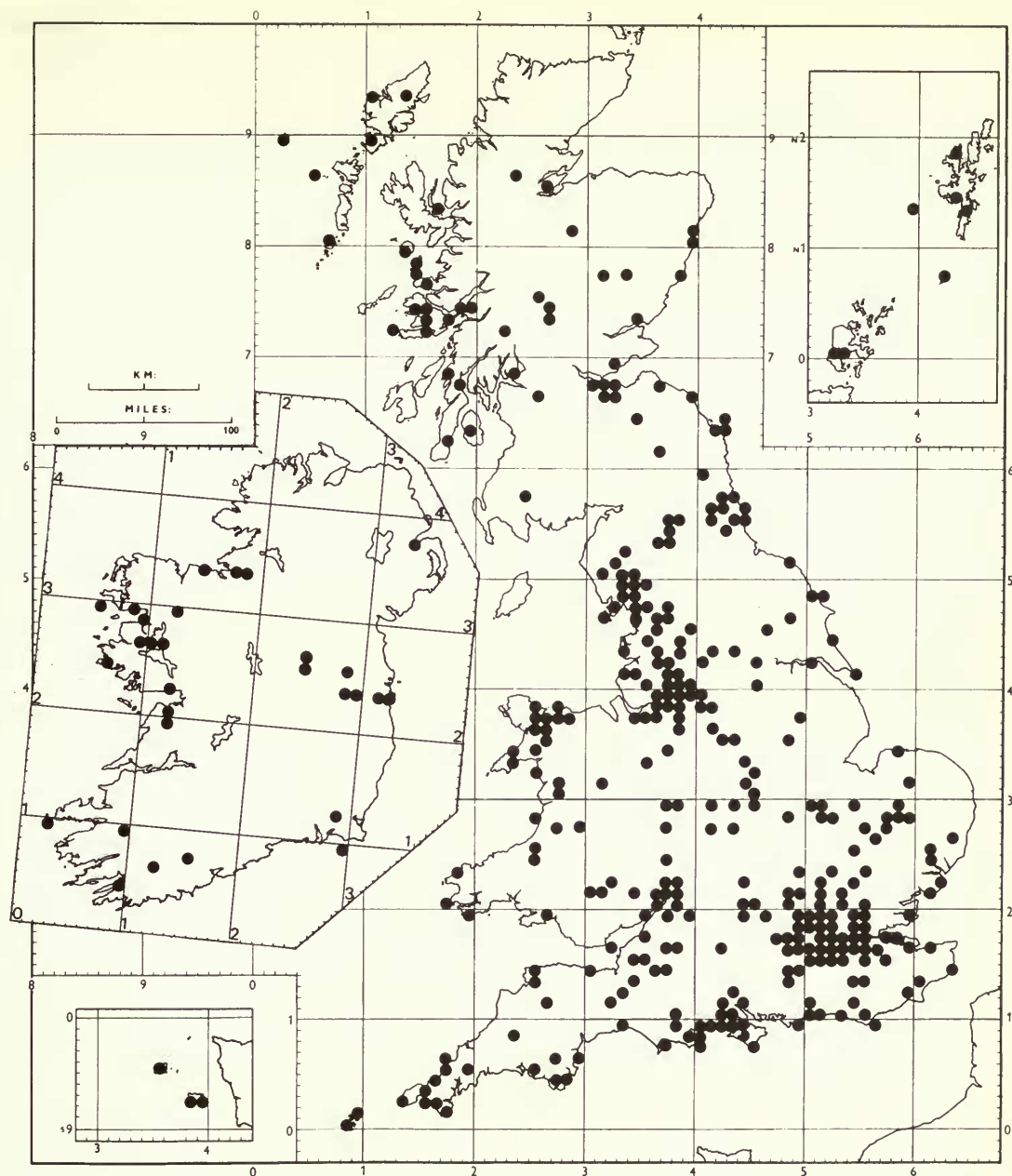
(c) A large part of the collections of the late Harry Britten senior, deposited partly in Manchester Museum and partly in the BM(NH), the latter forming part of the J. H. Murgatroyd collection, and Murgatroyd's own collection containing much useful material.

(d) A portion of the collections of the late Rev. J. E. Hull now deposited in the BM(NH).

(e) A considerable number of samples or individual specimens from freelifving habitats or associated with beetles and bumblebees, sent to the Museum by naturalists, ecologists, students, or members of the public.

The map, figure 1, shows to the nearest 10-kilometre square on the National and Irish Grids the extent of Berlese-funnel and other samples examined. It follows, therefore, that the blank areas are ones from which no collections have been examined, and not that mites are absent. The map does not show, however, the fact that one square may have been sampled





**Fig. 1** The National and Irish Grids, showing to the nearest 10-kilometre square the extent of material examined during the preparation of the present work.

extensively, whilst another may be merely the result of a single specimen being collected from a very small sample or even from an individual 'host'. A handful of specimens bearing imprecise locality data have been examined. These are not shown on the map as in each case the county or general area of collection is already dotted. In keeping with most modern British biological recording schemes, the Channel Islands are included, although very few collections have been received from this area.

Consequently the overall distribution of individual species within the British Isles, and especially in Ireland, cannot at this stage be given, although their occurrence within the total

area sampled may indicate some trends and relative abundance. As Blower (1974) has concluded for the British millipedes, the incomplete coverage of the country so far makes it premature to discuss reasons for apparent patterns of distribution, although some comments are made under individual species.

Localities are given mainly under the 'old' established counties as this is in keeping with the published reviews of most groups, both plant and animal. Additionally, large urban areas, e.g. Manchester and London, and islands or individual but prominent localities, e.g. Isle of Wight, Lundy, Dungeness and Helvellyn, are given as such. For the scarcer species only, full data are given for each sample. The vast majority of the specimens are curated into the National Collection.

It is intended to continue to accumulate data on British material with a view to updating the distribution and habitat preferences using the present work as a foundation. Therefore fresh material will be gladly received, but even more valuable would be any attempts to rear in the laboratory the complete life-cycles of individual species (for instance *Parasitus magnus* and *berlesei* and *Poecilochirus subterraneus*) as has been done for *Parasitus copridis* (see Costa, 1964).

The principal habitats from which the species documented in this work have been recorded are set out in table 1.

Of the thirty-six species recorded, thirty-five are from Britain and twenty-six are from Ireland. *Trachygamasus gracilis* (Karg) has so far been recorded only in Counties Meath and Kildare, but no significance can be attached to this fact (see also comments on p. 363).

## Methods

All material not already permanently mounted on slides has been cleared and examined as temporary slide-mounts in lactic acid, either on being transferred direct from alcohol or, in a few cases, from being preserved dry. Measurements and figures are based on the natural non-compressed curvature of, for instance, the dorsal shields (unless stated otherwise), but measurements of setae are only given of a flat and straight aspect. Details of ornamentation and structure are compared with subsequent specimens and where variations are noted these are, if considered of importance, figured separately. Where many specimens are contained within a single sample (as for instance in *Poecilochirus carabi*) a selection of apparent size and colour forms are cleared and checked for possible significant variation. With little practice a few species can be recognized in alcohol under low magnification as certain degrees of sclerotization and colour tones are more apparent before clearing, e.g. the sternal region of deutonymphs of *Parasitus consanguineus* and *fimetorum* and *Parasitellus fucorum*. Also the difference in the dorsal chaetotaxy between *Parasitus coleoptratorum* and *copridis* is readily seen.

With few exceptions all the figures have been made by camera lucida. The exceptions are when certain developmental stages have not been found in this country, and in these instances the figures are based on those of other authors and are acknowledged accordingly.

## External morphology

The external morphology of the Parasitidae is described at length by Micherdzinski (1969), whilst Bhattacharyya (1963) has discussed that of *Pergamasus* s. lat. However, the terminology used to describe the external morphology of the Acari has been subject to considerable variation, and in the Mesostigmata this has been most pronounced in the gnathosoma. The present simplified account largely follows that of Evans and Till (1979) who base their treatment for the gnathosoma on the freeliving members of the suborder Gamasina, which includes the Parasitidae.

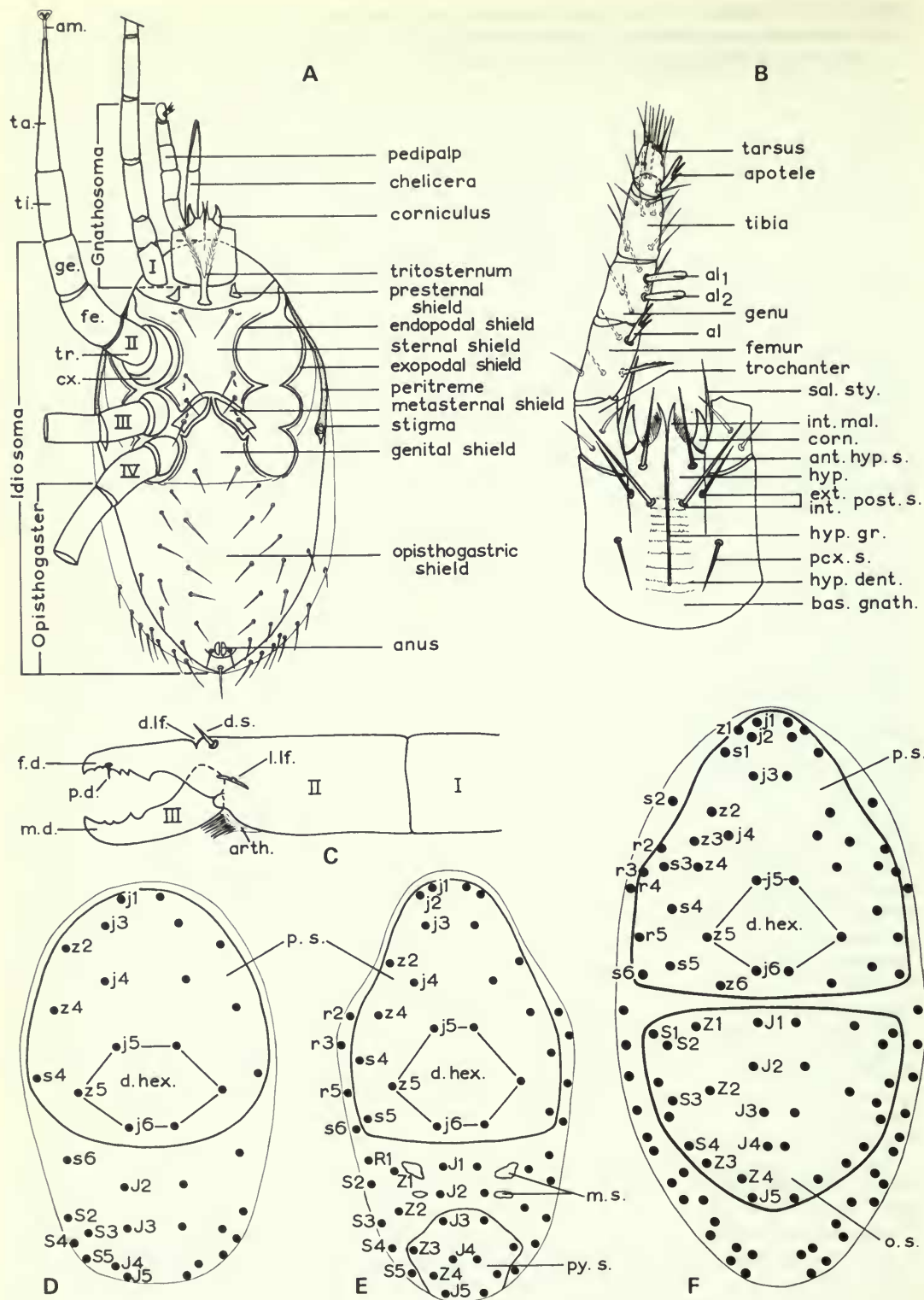
**Table 1** Guide to principal habitat preferences in the British and Irish species of Parasitinae.

M = most frequent habitat, L = less frequent habitat, I = single isolated record, O = the only habitat recorded in the British Isles. Non-British habitats are marked 'x' where different or more frequent.

| Parasitine species                   | Habitat or association |                   |                              |               |                        |                      |          |                     |                     |                            |                   |                              |                      |                         |                                 |
|--------------------------------------|------------------------|-------------------|------------------------------|---------------|------------------------|----------------------|----------|---------------------|---------------------|----------------------------|-------------------|------------------------------|----------------------|-------------------------|---------------------------------|
|                                      | Bumblebees             | Other Hymenoptera | Scarabaeid or ground beetles | Other insects | Mammals or their nests | Birds or their nests | Seashore | Arable or grassland | Leaf-litter, mosses | Houseplant/greenhouse soil | Hay, straw, grain | Compost (rotting vegetation) | Manure, dung, sewage | Corpses/sextion-beetles | Fungi (including mushroom beds) |
| <i>Parasitus coleopratorum</i>       |                        |                   | M                            | I             | L                      | L                    | L        | L                   | M                   |                            | I                 | M                            | M                    | I                       | I                               |
| <i>Parasitus beta</i>                | x                      |                   | L                            |               | Ix                     |                      | I        | M                   | x                   |                            |                   | Ix                           | x                    |                         |                                 |
| <i>Parasitus consanguineus</i>       | I                      |                   |                              | L             |                        | L                    | L        | x                   | L                   |                            | M                 | M                            | M                    |                         | L                               |
| <i>Parasitus copridis</i>            |                        |                   | O                            |               |                        |                      |          |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Parasitus evertsi</i>             |                        |                   |                              |               | I                      |                      | L        |                     | I                   | L                          |                   |                              | L                    |                         | I                               |
| <i>Parasitus fimetorum</i>           | L                      |                   | L                            |               | L                      | L                    | I        |                     | L                   |                            |                   | M                            | M                    | I                       |                                 |
| <i>Parasitus hyalinus</i>            |                        |                   |                              |               |                        | I                    |          | L                   |                     |                            |                   | x                            | I                    |                         | L                               |
| <i>Parasitus insignis</i>            |                        |                   |                              |               |                        |                      |          | O                   |                     | x                          |                   |                              |                      |                         |                                 |
| <i>Parasitus kempersi</i>            |                        |                   |                              |               |                        |                      | O        |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Parasitus loricatus</i>           | I                      | L                 |                              |               | M                      | M                    |          |                     | L                   |                            |                   | M                            | L                    |                         | M                               |
| <i>Parasitus mustelarum</i>          |                        |                   | M                            |               | Lx                     |                      |          |                     |                     |                            | x                 | x                            | x                    |                         | x                               |
| <i>Vulgarogamasus burchanensis</i>   |                        |                   |                              |               |                        |                      |          |                     |                     |                            | Lx                | I                            |                      |                         |                                 |
| <i>Vulgarogamasus immanis</i>        |                        |                   |                              |               |                        |                      | O        |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Vulgarogamasus kraepelini</i>     |                        | I                 |                              |               | M                      |                      |          | L                   | M                   |                            |                   |                              |                      |                         | L                               |
| <i>Vulgarogamasus oudemansi</i>      |                        |                   |                              |               | M                      | M                    |          |                     | I                   |                            |                   |                              |                      |                         |                                 |
| <i>Vulgarogamasus remberti</i>       |                        |                   |                              |               | M                      | L                    |          |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Vulgarogamasus trouessarti</i>    |                        |                   |                              |               |                        |                      | O        |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Eugamasus magnus</i>              |                        |                   |                              |               | I                      |                      |          |                     | M                   |                            |                   |                              |                      |                         |                                 |
| <i>Eugamasus berlesei</i>            |                        |                   |                              |               | M                      |                      |          |                     | M                   |                            | I                 | L                            |                      |                         |                                 |
| <i>Eugamasus cavernicola</i>         |                        |                   |                              |               | L                      |                      |          |                     | I                   |                            |                   |                              |                      |                         |                                 |
| <i>Eugamasus crassitarsis</i>        |                        |                   |                              |               |                        |                      |          | M                   | L                   |                            |                   |                              |                      |                         |                                 |
| <i>Porrhostaspis lunulata</i>        |                        |                   |                              |               | L                      |                      | I        | M                   | M                   |                            |                   | M                            | M                    | M                       |                                 |
| <i>Cornigamasus lunaris</i>          |                        |                   |                              |               |                        |                      | L        |                     |                     |                            | M                 | M                            | M                    |                         |                                 |
| <i>Parasitellus fucorum</i>          | M                      | L                 |                              | L             |                        |                      |          |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Parasitellus crinitus</i>         | M                      |                   |                              |               | I                      |                      |          |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Parasitellus ignotus</i>          | M                      |                   |                              |               |                        | I                    |          |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Parasitellus talparum</i>         | M                      |                   |                              |               | L                      |                      |          |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Gamasodes spiniger</i>            |                        |                   |                              | L             | L                      | I                    | I        | L                   | L                   |                            | L                 |                              |                      | I                       |                                 |
| <i>Gamasodes bispinosus</i>          |                        |                   |                              | I             |                        |                      | Lx       | x                   |                     | I                          |                   | x                            |                      |                         |                                 |
| <i>Gamasodes fimbriatus</i>          |                        |                   |                              |               |                        |                      | O        |                     |                     |                            |                   |                              |                      |                         |                                 |
| <i>Poecilochirus carabi</i>          |                        |                   | L                            | L             | L                      | L                    |          |                     |                     |                            |                   |                              |                      | M                       |                                 |
| <i>Poecilochirus austroasiaticus</i> |                        |                   |                              |               |                        |                      |          |                     | x                   |                            |                   |                              |                      | M*                      |                                 |
| <i>Poecilochirus davydovae</i>       |                        |                   |                              |               |                        |                      |          |                     |                     |                            |                   |                              |                      | O                       |                                 |
| <i>Poecilochirus subterraneus</i>    |                        |                   | L                            | L             |                        |                      |          |                     | I                   |                            |                   |                              |                      | M                       |                                 |
| <i>Trachygamasus ambulacralis</i>    |                        |                   |                              |               | I                      |                      | I        | x                   | L                   |                            |                   |                              | L                    |                         |                                 |
| <i>Trachygamasus gracilis</i>        |                        |                   |                              |               |                        |                      |          | O                   |                     | x                          |                   |                              | x                    |                         |                                 |

\*See text, p. 358.





In all post-embryonic developmental stages the body is divided into two well-defined regions, the *gnathosoma*, or *capitulum*, which carries the *pedipalps* and *chelicerae*, and the *idiosoma* which bears the ambulatory appendages, the *legs* (Fig. 2A). The gnathosoma is articulated antero-ventrally to a cavity of the idiosoma, the *camerostome*.

### Gnathosoma

The major part of the gnathosoma is formed by the enlarged *coxae* of the pedipalps which are extended dorsally and ventrally to form a sclerotized tube, the *basis gnathosomatica* (*bas. gnath.*) (Fig. 2B). The roof of the basis gnathosomatica is developed anteriorly to form the *gnathotectum*, or *tectum*, which in many species terminates in a strongly trispinate process (Figs 14D, 38J), or in some as a broad irregular triangle (Figs 22C, D, 24K). Ventrally the gnathosoma bears a median *hypognathal groove* (*hyp. gr.*) which is provided with transverse rows of *denticles* (*hyp. dent.*), and from two to four pairs of setae. In the larva only the *anterior hypostomatic* (*ant. hyp. s.*) and the *external posterior hypostomatic setae* (*ext. post. s.*) are present (Fig. 12F); but at the protonymph stage the *internal posterior hypostomatic* (*int. post. s.*) and the *palpcoxal setae* (*pcx. s.*) are added (Figs 12M, 13F, L, 14G).

The antero-ventral region of the gnathosoma, the *hypostome* (*hyp.*), bears, in addition to the hypostomatic setae, two pairs of anteriorly directed processes, the fringed *internal malae* (*int. mal.*) and the horn-like *external malae* or *corniculi* (*corn.*), the latter being probably of setal origin. In the genus *Cornigamasus*, the very long corniculi are grooved to accommodate the 'salivary' *styli* (*sal. sty.*) which are ventro-lateral to the chelicerae (Fig. 41M), whereas in the remaining genera the corniculi are without grooves and the styli arise laterally or dorso-lateral to the chelicerae.

### Chelicerae

The paired retractile chelicerae, which are located within the tubular region of the gnathosoma, are essentially feeding organs and are chelate (Fig. 2C). Each is divided into three segments or articles, the *basal article* (I) to which the retractor muscles are attached, the *middle article* (II) which terminates in the *fixed digit* (*f. d.*), and the *movable digit* (*m. d.*) (III) which is articulated ventrally with and opposes the fixed. Both digits are dentate, and in the male (Fig. 8L), the movable digit bears a sclerotized appendage, the *spermatodactyl* (*sp.*), which during copulation plays an important part in sperm transfer. In the Parasitidae the spermatodactyl is fused with the movable digit distally and a foramen, the *spermatotreme* (*sptr.*), is formed. Additionally each chelicera bears in the region of the fixed digit, two setae, the *dorsal seta* (*d. s.*) and the *pilus dentilis* (*p. d.*) (possibly a chemoreceptor), and two *lyriform fissures* (mechano-receptors), the *dorsal lyrifissure* (*d. lf.*) and the *lateral lyrifissure* (*l. lf.*). The *articulating* (or *arthrodial*) *membrane* (*arth.*) at the base of the movable digit is setiform.

### Pedipalps

The pedipalps (or palps) have five free articulated *podomeres* or segments, *trochanter*, *femur*, *genu*, *tibia* and *tarsus* (Fig. 2B), and their chaetotaxy, which is constant in each developmental stage, may be shown by the following formula: larva – trochanter 0 (no setae), femur 4, genu 5, tibia 12, tarsus 11; protonymph – 1, 4, 5, 12, 15; deutonymph and adults – 2, 5, 6, 14, 15. Figures 12G, 12N and 13K show the chaetotaxy of a typical trochanter, femur and genu for larva, protonymph and adult respectively. Additionally the tarsus bears on its inner basal angle a movable flattened fork-like structure, an *ambulacrum*

Fig. 2 A diagrammatic representation of the venter of a female parasitine mite; B venter of the gnathosoma (excluding chelicerae); C lateral view of chelicera of a typical parasitine deutonymph or female; D–F basic nomenclature of dorsal sclerotization and chaetotaxy of a typical parasitine larva (D), protonymph (E) and deutonymph (F); I–IV, legs I–IV. Abbreviations in text, pp. 243–6.

or *apotele*. The *anterolateral setae* on the femur, *al*, and on the genu, *al*<sub>1</sub> and *al*<sub>2</sub>, are variously modified and form useful key characters.

## Idiosoma

### *Dorsal chaetotaxy and sclerotization*

In general the Parasitinae differ conspicuously from the Pergamasinae in the diversity of the dorsal setae and in the degree of development of the dorsal sclerotization. In the Pergamasinae the dorsal setae are usually of uniform length and thickness, whereas in the majority of species of Parasitinae the setae are heterogeneous. Females of the Pergamasinae have an entire (*holodorsal*) shield which completely covers the idiosoma, whereas females of the Parasitinae generally have separate anterior (*podonotal*) and posterior (*opisthonotal*) shields, *p.s.* and *o.s.* respectively (Fig. 4A), or occasionally a *schizodorsal* shield in which the podonotal and opisthonotal shields are fused medially only and bear lateral incisions (Fig. 52L). The males of some species of Pergamasinae have a transverse suture between the podonotal and opisthonotal regions, whilst in others there is complete fusion. In the Parasitinae all males have a median transverse suture.

The dorsal chaetotactic pattern is widely used as a taxonomic criterion in the Mesostigmata, and the system followed in the present work is that of Lindquist and Evans (1965).

The basic nomenclature of the dorsal idiosomal chaetotaxy of a typical parasitine larva, protonymph and deutonymph are shown in figures 2D, E and F respectively. Four paired longitudinal rows of setae are designated as follows: dorsocentral (*j*, podonotal and *J*, opisthonotal), mediolateral (*z* and *Z*), lateral (*s* and *S*) and marginal (*r* and *R*). Setae *r*1 and *Z*5 do not occur in the Parasitidae. The deutonymphal chaetotaxy is retained in the adults. Setae *j*5, *z*5 and *j*6 form the *dorsal hexagon* (*d. hex.*) which may assist in establishing the boundary between the podonotal and opisthonotal regions in those Mesostigmata possessing a holodorsal shield, and is also a useful term to apply when describing the podonotal chaetotaxy. Setae *j*1, *z*1 and *r*3 are often referred to as the *vertical*, *paravertic* and *humeral* setae respectively. In those species in which the opisthonotal shield is hypertrichous, for example members of the genus *Parasitellus*, it is not always possible to define the *J*, *Z*, *S* and *R*-series (Fig. 44A).

The larva and protonymph are usually weakly sclerotized and the dorsal plates, although following a definite developmental sequence (Bhattacharyya, 1963, Evans and Till, 1979), may be poorly defined or apparently absent. In the larva (Fig. 2D) the podonotal region bears 10 pairs of setae of which nine are on the *podonotal shield* (*p. s.*), and the opisthonotal region bears eight pairs on unsclerotized cuticle. The protonymph (Fig. 2E) bears 11 pairs of setae on the podonotal shield and four pairs on the adjacent membrane, whilst the opisthonotal region bears 13 or 14 pairs, depending on whether *R*1 is present or absent, and may or may not show partial sclerotization in the form of paired *mesonotal scutella* (*m. s.*) and a single *pygidial shield* (*py. s.*). The deutonymph (Fig. 2F) is much more heavily sclerotized than the preceding stages and the podonotal and opisthonotal shields are well defined. In most species the opisthonotal shield is almost as broad as the podonotal, but in some, for instance *Vulgarogamasus trouessarti* (Fig. 32A), it is noticeably narrower. Typically the podonotal region of the deutonymph bears 20 or more pairs of setae, almost all of which are on the shield, and the opisthonotal region bears 30 or so pairs with about half on the shield. As mentioned above species of *Parasitellus* bear additional setae on the opisthonotal shield. In the deutonymph of one species, *Vulgarogamasus immanis* (Fig. 24A), the podonotal shield is reduced and bears only 15–17 pairs of setae whilst the opisthonotal shield may bear as few as 11 pairs.

### *Venter*

The ventral surface of the idiosoma is furnished with a number of shields whose progressive development, degree of sclerotization and the setae they bear, follow a regular sequence as



described in the following paragraphs. The *endopodal* and *exopodal shields* (*end. sh.* and *ex. sh.*), which lie adjacent to the coxae of legs II–IV, are usually weakly developed or absent in the immature stages, although in the deutonymphs of *Poecilochirus* the endopodals are conspicuous at coxae IV (Fig. 55I). In the adults the exopodal shields are generally fused with the sclerotized peritrematal shields and the endopodals with the sternal/sternogenital shields, and may show as little more than strong borders to those regions (Fig. 2A). Lying between the coxae of the first pair of legs, and immediately behind the gnathosoma, is the *tritosternum* (Fig. 2A), a sensory organ which is normally present in all post-embryonic stages of the Parasitidae, but may be reduced or absent in the males of some species of the Parasitinae.

*Larva* (Fig. 12B). This instar bears three pairs of legs. The sternal, or intercoxal, region bears three pairs of setae, *sternal setae* (*st.*) I–III, but there is no clear indication of a sternal shield. The *anal shield* (*a. s.*) is usually very weakly sclerotized and bears a pair of long *paranal* or *adanal setae* (*pa.*) and a single long *postanal seta* (*po.*). Each *anal valve* (*a. v.*) is provided with a short *euanal seta* (*eu.*). The remainder of the region posterior to the coxae of the third pair of legs, the *opisthogaster*, bears four pairs of setae. *Stigmata* and *peritremes* are absent.

*Protonymph* (Fig. 12J). At this stage the fourth pair of legs appears and the intercoxal region bears four pairs of setae, *st.* I–III on the scarcely discernible sternal shield, and *st.* V (homologous to the female genital setae) between the coxae of the fourth pair of legs. Also appearing now are two pairs of *sternal pores* (*pst.*), I and II. The anal shield is still weakly sclerotized, but the paired paranal setae and the postanal seta are considerably shorter than in the larva. There are no euanal setae. The remainder of the opisthogastric region bears six pairs of setae. A pair of stigmata and short peritremes are present.

*Deutonymph* (Fig. 13B). At this stage the *sternal shield* (*st. sh.*) is well developed and in most species is strongly sclerotized. The base of the tritosternum is normally flanked by a pair of triangular *presternal shields* (*pst. sh.*). Five pairs of sternal setae are present, *st.* IV (the *metasternal setae* of the female) having emerged at this stage in association with a third pair of pores, *pst.* III. The anal shield is strongly sclerotized and in most species bears only the paranal and postanal setae, although in some one or more pairs of opisthogastric setae may be located on the anterior margin of the shield (Figs 30B, 32B, C). The opisthogastric membrane may bear about ten to over 60 pairs of setae. Stigmata are present and the peritremes extend anteriorly to the region of the coxae of leg I. Small *metapodal shields* (*mp. sh.*) are present at this stage.

*Male* (Fig. 13H). The entire idiosoma is sclerotized except for ventrally the regions of attachment of the legs and gnathosoma (see also Fig. 11B). The *genital orifice* (*g. o.*) is situated at the anterior margin of the *sternogenital shield* (*stgen. sh.*) and the *genital lamina* (*g. l.*) may cover the base of the tritosternum, which may be reduced, or in some species, absent. The presternal shields can be absent or barely discernible. The ventral chaetotaxy resembles that of the female of the same species.

*Female* (Fig. 2A). The tritosternum is as in the deutonymph. The deutonymphal sternal shield bearing four pairs of setae and three pairs of pores has become a sternal shield bearing *st.* I–III and *pst.* I–II, and a pair of *metasternal shields* bearing *st.* IV and *pst.* III. The large triangular flap-like genital shield, which bears *st.* V, overlies the genital orifice and is hinged to the opisthogastric shield level with the posterior margin of coxae IV. Within the genital orifice are usually visible characteristically shaped endogynial processes (for example Fig. 14C). The extent of sclerotization of the opisthogastric shield varies between species and consequently the proportions of opisthogastric setae on the shield and on the surrounding membrane varies. The anal shield is fused with the opisthogastric shield.

### Legs

Three pairs of legs are present in the larva and four pairs in the protonymph, deutonymph and adults. All legs have six segments or podomeres, namely – from the idiosoma – *coxa*



(cx.), trochanter (tr.), femur (fe.), genu (ge.), tibia (ti.) and tarsus (ta.) (Fig. 2A), and all bear distally on the tarsus an *ambulacrum* (am.) comprising a *pretarsus* (pt.), a pair of *claws* (cl.) and a lobed *pulvillus* (pulv.) (Figs. 2A, 64I). The ambulacra of legs II–IV are stouter than on leg I. The first pair of legs are slender and are directed anteriorly and used primarily as a sensory appendage during locomotion. In the male leg II is modified for grasping the female during copulation and is usually considerably thickened, with the femur, genu and tibia bearing strong spurs ventrally (Fig. 13M). In some species the tarsus of leg II may also bear spurs or hypertrophied setae (Figs 34H, I).

Detailed studies on the numbers and distributional patterns of setae on the leg segments in the Mesostigmata have been conducted in recent years and these provide characters that are valuable at all levels of classification. Concise details of podomeric chaetotaxy are given by Evans and Till (1979), but in the present work the leg setae are mainly referred to in general terms, or individual setae are described when a particular species possesses conspicuously long, short or modified examples. Spurs or hypertrophied setae are generally figured.

So far as I am aware, in the deutonymph of only one British species of the Parasitinae, namely *Parasitus loricatus* (p. 283), is it possible to determine the sex of the future adult by distinct external morphological features, although frequently the developing adult is visible within the deutonymph when the specimen has been cleared for examination. I have no evidence to support the statement accredited to D. E. Johnston (Lundqvist and Micherdzinski, 1975) that the female deutonymphs of the Parasitidae have a star-shaped reticulated configuration posteriorly on the sternal shield, whilst the males have no such formation. Certainly this feature does not hold good for *P. loricatus*.

#### Family PARASITIDAE Oudemans

GAMASIDAE ['Gamasides'] Leach, 1815. *Trans. Linn. Soc. Lond.* **11**: 396.

PARASITINAE Oudemans, 1901. *Tijdschr. ned. dierk. Vereen.* **7**: 59.

POECILOCHIRIDAE Willmann, 1940. *Zool. Anz.* **130**: 215.

SAPROGAMASIDAE Willmann, 1949. *Veröff. Mus. nat.-Völker-Handelsk. Bremen* **A1**: 136.

EUGAMASINAE Hirschmann, 1962. *Acarologie* **5**(5): 39.

#### Summary of classification

The first major review of the family Parasitidae was Berlese's 'Monografia del genere *Gamasus* Latr.' published in 1906, in which he recognized the following eight subgenera: *Amblygamasus* Berlese, 1904a, *Eugamasus* Berlese, 1892a, *Gamasus* Latreille, 1802, *Halolaelaps* Berlese and Trouessart, 1889 (now in the family Halolaelapidae Karg, 1965), *Laelogamasus* Berlese, 1905 (now in the family Rhodacaridae Oudemans, 1902b), *Ologamasus* Berlese, 1906 (*nec* Berlese, 1888), *Pergamasus* Berlese, 1904a, and *Trachygamasus* Berlese, 1904a. Most subsequent workers, for example Baker and Wharton (1952), who covered the world fauna, and Evans (1957), who dealt with the British fauna, have based their classifications on Berlese's monograph.

More recently, Micherdzinski (1969), in his extensive review of the family, recognized the genera *Gamasodes* Oudemans, 1939a, *Holoparasitus* Oudemans, 1936 (= *Ologamasus*), *Oocarpais* Berlese, 1916, *Parasitus* Latreille, 1795 (including *Eugamasus*), *Pergamasus*, *Poecilochirus* G. and R. Canestrini, 1882, and *Saprogamasus* Willmann, 1949b (= *Trachygamasus*). *Holoparasitus*, *Parasitus* and *Pergamasus* he divided into species groups.

Holzmann (1969)\* restricted *Parasitus* to *Acarus fucorum* De Geer, 1778, plus a new species, *Parasitus willmanni*. The other genera she recognized are *Eugamasus*, *Gamasodes*, *Ologamasus*, *Pergamasus*, *Poecilochirus*, and *Trachygamasus*. The monotypic Indian genus *Oocarpais* she considered to be a synonym of *Pergamasus*. The description of the new genus *Willmanniella* Götz, 1969, with its type species *W. fallax* sp. nov., is taken from a thesis of 1952 at the Zoologischen Institut, Erlangen, and is incorporated into Holzmann's text where it is considered to be a synonym of *Trachygamasus*.

\*This paper is a summary of the author's 1955 thesis from the Zoologischen Institut, Erlangen, which is deposited in the Bayerischen Staatsbibliothek, Munich.

Tichomirov (1969) considers previous views on the separation of *Parasitus* and *Eugamasus* and proposes the division of *Parasitus* into five subgenera, *Coleogamasus* Tich., *Eugamasus*, *Neogamasus* Tich., *Parasitus* and *Vulgarogamasus* Tich. *Neogamasus* is not further considered here as so far none of the species assigned to it has been recorded in the British Isles.

Karg (1971) favours the subfamily Parasitinae of the Eugamasidae Hirschmann, 1962 and, like Micherdzinski (1969), combines *Parasitus* with *Eugamasus*, but does not group the species. He recognizes *Gamasodes*, *Holoparasitus*, *Parasitus*, *Pergamasus*, *Poecilochirus* and *Trachygamasus*.

Juvara-Bals (1972) proposed the division of the Parasitidae into two subfamilies, the Parasitinae and the Pergamasinae, and Evans and Till (1979), in adopting this separation, have produced a practical classification for the British Parasitinae in which they recognize the following nine genera: *Cornigamasus* Evans and Till, *Eugamasus*, *Gamasodes*, *Parasitellus* Willmann, 1939b, *Parasitus*, *Poecilochirus*, *Porrhostaspis* Müller, 1859, *Trachygamasus* and *Vulgarogamasus*. In the Pergamasinae they include the following five genera: *Amblygamasus*, *Holoparasitus*, *Paragamasus* Hull, 1918, *Pergamasellus* Evans, 1957, and *Pergamasus*. Most of the British Pergamasinae were revised by Bhattacharyya (1963) in his review of *Pergamasus* s. lat., although additional species have since been collected. The remaining British genus of this subfamily, namely *Holoparasitus*, is at present in course of revision (Hyatt, in prep.). However, Athias-Henriot has, since 1967, produced a series of papers on the Parasitidae in which a number of new genera and subgenera are proposed and others are redefined. Where her changes involve British species, these are cited in the relevant synonymy, but for practical purposes I am following the generic concepts of Evans and Till (1979).

The two subfamilies may be separated as follows:

- 1 Females with separate podonotal and opisthonotal shields, or occasionally a schizodorsal shield (Fig. 52L); tritosternum of male normal, similar to that of the female (Fig. 39I), or modified (Fig. 6B), or absent; setae  $z5$  of dorsal hexagon in adults and deutonymph may differ markedly in form from  $j5$  and  $j6$  (Fig. 3A), or only slightly (Fig. 26A), or the three pairs of setae may be homogeneous (Fig. 32A) . . . . . subfamily **PARASITINAE** Oudemans, 1901
- Females with dorsal shield entire; tritosternum of male always biramous with a reduced base which is covered by the genital lamina; all setae of dorsal hexagon, that is  $z5$ ,  $j5$  and  $j6$ , of similar length and form . . . . . subfamily **PERGAMASINAE** Juvara-Bals\*, 1972

### Key to the British genera of Parasitinae based on the deutonymphs and adults

- 1 Setae  $al_1$  and  $al_2$  of palp genu in deutonymph and adults bifid (Fig. 35K) . . . . . **EUGAMASUS**. Berlese, 1892a (p.310)
- Setae  $al_1$  and  $al_2$  of palp genu entire, spatulate (Fig. 58E) or setiform (Fig. 15E) . . . . . 2
- 2 Opisthogaster hypertrichous, typically with more than 40 pairs of setae (Figs 48B, H, 49B). Associated with *Bombus* . . . . . **PARASITELLUS** Willmann, 1939b (p. 327)
- Opisthogaster with rarely more than 30 pairs of setae . . . . . 3
- 3 Corniculi in deutonymph and adults long, slender, parallel and extending beyond anterior margin of palp trochanter; corniculi grooved to accommodate 'salivary' styli which arise ventro-lateral to the chelicerae (Fig. 41M); anterior margin of opisthonotal shield distinctly concave in deutonymph and female (Fig. 41A, H) . . . . . **CORNIGAMASUS** Evans and Till, 1979 (p. 324)
- Corniculi short, not extending to anterior margin of palp femur, lacking grooves; 'salivary' styli arising lateral or dorso-lateral to chelicerae; anterior margin of opisthonotal shield not concave . . . . . 4
- 4 Genital shield of female elongate, tricuspid anteriorly (Fig. 40B); male chelicerae asymmetrical due to presence of digitiform process on the spermatodactyl of the right chelicera (Fig. 39L, M) . . . . . **PORRHOSTASPIS** Müller, 1859 (p. 320)

\*Evans and Till, 1979 give Athias-Henriot, 1973.

- Genital shield of female subtriangular in outline, never tricuspid anteriorly; male chelicerae symmetrical . . . . . 5
- 5 Seta *al* of palp femur spatulate (Fig. 57E) or setiform (Fig. 51E), at the most spiculate distally (Fig. 64G); idiosoma less than 2000  $\mu$ m . . . . . 6
- Seta *al* of palp femur bifid (Fig. 5E) or with one or more distinct slender processes (Fig. 26F); if spatulate however (*Vulgarogamasus immanis*, Fig. 25F) idiosoma greater than 2000  $\mu$ m in length . . . . . 8
- 6 Setae *z5* of dorsal hexagon of female similar in type to *j6*; with distinct podonotal and opisthonotal shields in female (these may be partly fused, Fig. 59A); corniculi of male usually hooked (Fig. 56F); tritosternum normal; sternal shield of deutonymph with dark transverse band (Fig. 57B) . . . . . **POECILOCHIRUS** G. & R. Canestrini, 1882 (p. 349)
- Setae *z5* of dorsal hexagon of female differing in length and form from *j6* (Fig. 9A); if similar, then female with schizodorsal shield (Fig. 52L); male corniculi not hooked; tritosternum of male absent or modified, never biramous . . . . . 7
- 7 Female with two dorsal shields or with schizodorsal shield; suture between metasternal and sternal shields conspicuous and forming an inverted V (Fig. 51B); ambulacra of legs II-IV with lateral lobes of pulvillus inconspicuous, rounded; leg II of deutonymph with spurs (Fig. 52G) . . . . . **GAMASODES** Oudemans, 1939a (p. 340)
- Female with two dorsal shields; metasternal shields fused with sternal shield or separated by a complete or incomplete transverse suture (Fig. 64D); ambulacra of legs II-IV with lateral lobes of pulvillus long acuminate (Fig. 64I); leg II of deutonymph without spurs . . . . . **TRACHYGAMASUS** Berlese, 1904a (p. 363)
- 8 With few exceptions, setae *z5* of dorsal hexagon markedly different in form from *j5* and *j6*, usually stout and setose; tritosternum of male absent or variously modified (Fig. 21G), if biramous, base closely associated with genital orifice (Fig. 8J) . . . . . **PARASITUS** Latreille, 1795 (p. 256)
- Setae of dorsal hexagon essentially similar in form, none outstandingly different (Fig. 24H); tritosternum normal in both sexes, base never closely associated with the genital orifice of the male (Fig. 26I) . . . . . **VULGAROGAMASUS** Tichomirov, 1969 (p. 290)

## Synonymy

The synonymy given is not intended to be exhaustive or complete. The principal synonyms only are given together with those that are relevant to literature on the British and Irish fauna. The interpretations of European species as given by Holzmänn (1969), Micherdzinski (1969) and Karg (1971) are generally accepted. However, it must be emphasized that the key characters chosen by these authors are in some cases variable. This has been proved by examination of series of specimens which show variations that would place them in different parts of their keys, and thus conspecific specimens would be identified as belonging to different species.

## Key to deutonymphs

- 1 Leg II with conspicuous ventral spurs, usually on the femur, genu tibia and tarsus (Fig. 50G); presternal shields conspicuous, elongate, and sternal shield of characteristic outline (Fig. 50B); dorsal setae mainly short, some may be stouter and pilose distally . . . . . **Gamasodes** 2
- Leg II without spurs; presternal and sternal shields variously formed (Figs 21B, 48B); dorsal setae of extreme lengths (Figs 3A, 39A, 46A) . . . . . 4
- 2 Femur II with two ventral spurs, tibia with none (Fig. 52G); dorsal setae *j1* and *r3* stout and pilose distally, remaining setae simple . . . . . **Gamasodes bispinosus** (Halbert) (p. 345)
- Femur and tibia II with one ventral spur each (Fig. 50G); more than two pairs of dorsal setae stout and pilose . . . . . 3



- 3 Ventral spur on femur II straight (Fig. 53D); all simple dorsal setae very short, rarely exceeding 20  $\mu\text{m}$  (Fig. 53A); lateral prongs of tectum poorly developed  
*Gamasodes fimbriatus* Karg (p. 347)
- Ventral spur on femur II thumb-shaped (Fig. 50G); dorsal setae longer (Fig. 50A); lateral prongs of tectum well developed (Fig. 50C)  
*Gamasodes spiniger* (Trägårdh) (p. 341)
- 4 Sternal shield with a transverse granular band between setae I and II (Fig. 55I); fixed digit of chelicera with a distal membranous process which may be rudimentary (Figs 55K, 60D)  
*Poecilochirus* 5
- Sternal shield without granular area; fixed digit of chelicera without membranous process 8
- 5 Transverse granular area of sternal shield extends posteriorly to form a narrow border (Fig. 62B) 6
- Transverse granular area of sternal shield not extending to setae III (Fig. 55I) 7
- 6 Majority of the dorsal setae long and reaching or passing the bases of the next seta (Fig. 62A)  
*Poecilochirus subterraneus* (Müller) (p. 361)
- Majority of dorsal setae short or very short, few only reaching the base of the next seta (Fig. 60A)  
*Poecilochirus davydovae* sp. n. (p. 358)
- 7 Podonotal shield not exceeding 450  $\mu\text{m}$ , opisthonotal shield *c.* 300  $\mu\text{m}$ ; setae *j5* and *J1* extending well beyond the bases of the next setae (Fig. 57A); fixed digit of chelicera with distal membranous process rudimentary (Fig. 57D)  
*Poecilochirus austroasiaticus* Vitzthum (p. 355)
- Podonotal shield exceeding 550  $\mu\text{m}$ , opisthonotal shield exceeding 400  $\mu\text{m}$ ; setae *j5* and *J1* reaching but rarely passing the bases of the next setae (Fig. 55H); fixed digit of chelicera with membranous process well developed  
*Poecilochirus carabi* G. & R. Canestrini (p. 350)
- 8 Dorsal shields characteristically outlined; posterior margin of podonotal shield strongly convex medially and anterior margin of opisthonotal shield strongly concave medially; all dorsal setae relatively short (Fig. 41A); corniculi long and slender (Fig. 41M), reaching at least the mid-point of the palp femur; tectum a single central prong with denticulate sloping margins (Fig. 41C)  
*Cornigamasus lunaris* (Berlese) (p. 324)
- Dorsal shields otherwise; corniculi normally much shorter, triangular (Fig. 10F) and only reaching the mid-point of the palp trochanter 9
- 9 Dorsal setae overall without extreme differences in length or stoutness although *j1*, *z5* and *r3* are generally the longest 13
- Some dorsal setae in addition to *j1*, *z5* and *r3* conspicuously stouter and longer than the remaining setae which are generally very short (Figs 10A, 21A) 10
- 10 Podonotal shield with setae *s6* unusually long; opisthonotal shield with 14 pairs of setae, *Z3* 250  $\mu\text{m}$  or longer (Fig. 10A); tectum with short broad central process and small hornlike lateral prongs (Fig. 10C)  
*Parasitus copridis* Costa (p. 267)
- Seta *s6* short; opisthonotal shield with more than 14 pairs of setae, *Z3* not exceeding 150  $\mu\text{m}$  (Fig. 3A) 11
- 11 Tectum quinque-spinate (Fig. 3C); seta *j4* long and pilose distally (Fig. 3A); opisthonotal shield with 16 pairs of setae; sternal shield blunt posteriorly and with setae *st. IV* situated near the posterior margin (Fig. 3B)  
*Parasitus coleoptratorum* (Linnaeus) (p. 256)
- Tectum trispinate; seta *j4* not conspicuously long; opisthonotal shield with 15 or 17 pairs of setae; sternal shield tapered posteriorly 12
- 12 Tectum with median spine three times as long as lateral spines (Fig. 21C); opisthonotal shield with 17 pairs of setae of which one pair, *Z3*, are stout and pilose (Fig. 21A); sternal shield broad, characteristically ornamented narrowing abruptly behind *psl. II* (Fig. 21B)  
*Parasitus mustelarum* Oudemans (p. 288)
- Tectum with median spine less than twice as long as lateral spines (Fig. 17C); opisthonotal shield with 15 pairs of setae of which *Z3* are long and stout and *J5* are thornlike and with a small conspicuous median mark slightly anterior to *J5* (Fig. 17A); sternal shield narrower, of more usual proportions (Fig. 17B); restricted to the seashore  
*Parasitus kempersi* Oudemans (p. 280)
- 13 Opisthogastric membrane densely setose, with over 40 pairs of setae (Fig. 48B); normally associated with *Bombus* spp. and their nests 14
- Opisthogastric membrane with less than 30 pairs of setae 17
- 14 Sternal shield broad and with conspicuous longitudinal striations within the laterally arranged reticulations (Fig. 42B); opisthonotal shield triangular, clearly narrower than the podonotal and with 15 pairs of setae (Fig. 42A)  
*Parasitellus fucorum* (De Geer) (p. 328)
- Sternal shield narrower, without striations; opisthonotal shield with more than 20 pairs of setae 15

- 15 Opisthogastric setae very short, generally not exceeding 35  $\mu\text{m}$  (Fig. 48B); opisthonotal shield usually with 24 to 30 pairs of setae, *J*-series without additional setae (Fig. 48A) *Parasitellus talparum* (Oudemans) (p. 337)
- Opisthogastric setae clearly longer; opisthonotal shield usually with more than 35 pairs of setae some of which are situated among the *J*-series (Fig. 44A) . . . . . 16
- 16 Podonotal shield with an additional seta lying between *r5* and *s6*; additional setae among the *J*-series shorter than *J1–J3* (Fig. 46A); lateral margins of tectum toothed (Fig. 46C); anal shield with the normal three setae (Fig. 46B) *Parasitellus ignotus* (Vitzthum) (p. 334)
- Podonotal shield without additional setae between *r5* and *s6*; additional setae among the *J*-series as long as the *J*-setae; lateral margins of tectum smooth (Fig. 44A); anal shield with additional setae (Fig. 44B) . . . . . *Parasitellus crinitus* (Oudemans) (p. 331)
- 17 Anal shield with more than the usual three setae . . . . . 18
- Anal shield with only three setae . . . . . 22
- 18 Opisthonotal shield with 22 pairs of setae *Eugamasus berlesei* Willmann (p. 313)
- Opisthonotal shield with 15 or less pairs of setae . . . . . 19
- 19 Opisthonotal shield conspicuously small within the opisthonotal region and of characteristic shape (Figs 24A, 32A); tectum broad and strongly denticulate (Figs 24D, 32D); large species, considerably more than 1 mm; restricted to the seashore . . . . . 20
- Opisthonotal shield of more normal proportions; tectum simple, trispinate (Fig. 16C); size less than 1 mm . . . . . 21
- 20 Podonotal shield over 800  $\mu\text{m}$ ; opisthonotal shield usually over 500  $\mu\text{m}$ ; median part of tectum tapered (Fig. 24A); anal shield with one pair of preanal setae (Fig. 24B) *Vulgarogamasus immanis* (Berlese) (p. 292)
- Podonotal shield less than 600  $\mu\text{m}$ ; opisthonotal shield less than 400  $\mu\text{m}$ ; median part of tectum broad, denticulate and similar to lateral elements (Fig. 32D); anal shield with at least four preanal setae (Fig. 32B) *Vulgarogamasus trouessarti* (Berlese) (p. 307)
- 21 The majority of the dorsal setae, on both shields and membrane, long and slender, reaching beyond the bases of the succeeding setae, opisthonotal shield with 14 pairs of setae (Fig. 30A); posterior opisthogastric and extra-anal setae also reaching beyond the bases of the succeeding setae; postanal seta twice the length of the more slender paranal setae (Fig. 30B) *Vulgarogamasus remberti* (Oudemans) (p. 304)
- Dorsal setae, with few exceptions, short, not reaching the bases of the succeeding setae; opisthonotal shield with 13 pairs of setae (Fig. 16A); opisthogastric and anal setae much shorter (Fig. 16B) . . . . . *Parasitus insignis* (Holzmann) (p. 279)
- 22 Lateral prongs of trispinate tectum broad and strongly bifurcate (Fig. 8D); presternal shields conspicuous, elongate, wider than the anterior margin of the sternal shield; sternal shield usually fragmented anteriorly, with *st. I* situated on isolated areas (Fig. 8B); colour normally dull brown . . . . . *Parasitus consanguineus* Oudemans & Voigts (p. 263)
- Lateral prongs of trispinate tectum not strongly bifurcate; presternal shields small or rudimentary and sternal shield normal, entire, with *st. I* not isolated (Fig. 26B) . . . . . 23
- 23 Dorsal setae, excluding *z1*, *s1*, *s2*, *r2* and *r3*, markedly homogeneous, with *j4* and *z5* not conspicuously longer than the adjacent setae . . . . . 24
- Dorsal setae not homogeneous (Figs 13A, 39A) . . . . . 27
- 24 Dorsal setae short, majority on podonotal shield not reaching the base of the succeeding seta (Fig. 63A); ambulacra of legs II–IV with lateral lobes acute (Fig. 63E) *Trachygamasus* (p. 363)
- Dorsal setae long, majority on podonotal shield passing the base of the succeeding seta (Fig. 19A); ambulacra without acute lobes . . . . . 25
- 25 Tectum with lateral prongs either broad and tapering (Fig. 19D) or if slender, with central part characteristically lobed (Fig. 19C); all dorsal setae, except *z1*, *s1*, *s2* and *r2*, finely pilose (Fig. 19A) . . . . . *Parasitus loricatedus* (Wankel) (p. 283)
- Tectum with central prongs pointed and lateral prongs slender (Fig. 28C); few dorsal setae clearly pilose . . . . . 26
- 26 Podonotal shield over 470  $\mu\text{m}$  long; opisthonotal shield over 310  $\mu\text{m}$  long; sternal shield over 310  $\mu\text{m}$  long . . . . . *Vulgarogamasus oudemansi* (Berlese) (p. 300)
- Podonotal shield less than 450  $\mu\text{m}$  long; opisthonotal shield less than 290  $\mu\text{m}$  long; sternal shield less than 290  $\mu\text{m}$  long . . . . . *Vulgarogamasus kraepelini* (Berlese) (p. 297)
- 27 Anterolateral seta on palp femur deeply bifurcate (Fig. 5E); opisthonotal shield bearing 15 pairs of setae (Fig. 5A) . . . . . 28

- Anterolateral seta on palp femur not deeply bifurcate (Fig. 39G); opisthonotal shield with 10 pairs of setae (Fig. 39A) *Porrhostaspis lunulata* Müller (p. 320)
- 28 Setae *z5* and *j4* not longer than *z4*, *s4*, *s5* and *z6*, and *z5* not reaching the base of *z6* (Fig. 15A); sternal shield about 180  $\mu\text{m}$  long *Parasitus hyalinus* (Willmann) (p. 277)
- Setae *z5* and *j4* longer and stouter than adjacent setae and *z5* reaching the posterior margin of the podonotal shield (Fig. 13A); sternal shield more than 200  $\mu\text{m}$  long 29
- 29 Seta *s5* as stout as *z5* (Fig. 5A); sternal shield less than 250  $\mu\text{m}$  in length *Parasitus beta* Oudemans & Voigts (p. 260)
- Seta *s5* much finer than *z5* (Fig. 13A); sternal shield over 260  $\mu\text{m}$  in length *Parasitus fimetorum* (Berlese) (p. 271)

### Key to males

- 1 Opisthonotal region of dorsum with more than 70 pairs of setae (Fig. 48G); normally associated with *Bombus* spp. and their nests 2
- Opisthonotal region of dorsum with less than 70 pairs of setae (Figs 38A, 39H) 5
- 2 Podonotal setae generally long and reaching well beyond the bases of the succeeding setae (Fig. 48G) 3
- A few of the podonotal setae reaching beyond the bases of the succeeding setae (Fig. 44G) 4
- 3 Opisthonotal region with additional setae between *J1-J3* (Fig. 46G); opisthogastric region with c. 80 pairs of setae; postanal seta slightly longer than paranals (Fig. 46H) *Parasitellus ignotus* (Vitzthum) (p. 334)
- No additional setae between *J1-J3*; opisthogastric region with c. 50 pairs of setae; postanal seta clearly longer and stouter than paranals (Fig. 48H) *Parasitellus talparum* (Oudemans) (p. 337)
- 4 Opisthonotal region bearing up to 80 pairs of setae and with additional setae within the *J*-series (Fig. 44G); opisthogastric setae long, anal setae subequal (Fig. 44H). *Parasitellus crinitus* (Oudemans) (p. 331)
- Opisthonotal region with up to 100 pairs of setae; no additional setae in the *J*-series (Fig. 42H); opisthogastric setae shorter, postanal seta stout and up to three times as long as the paranals (Fig. 42I) *Parasitellus fucorum* (De Geer) (p. 328)
- 5 Podonotal setae *j1*, *j4*, *z5* and *r3*, and usually at least one pair of opisthonotal setae, frequently stout and pilose and clearly longer than the remaining setae except the short *z1*, *s1*, *s2*, *r2* series 6
- With the exception of *z1*, *s1*, *s2*, *r2* and *r3* all dorsal setae of approximately equal length 20
- 6 Tritosternum present, either well developed (Fig. 41E) or rudimentary (Figs 3G, 53F) 7
- Tritosternum absent 18
- 7 Tritosternum well developed although the base may be short (Fig. 11B) 8
- Tritosternum rudimentary with the base and/or the laciniae atrophied (Figs 3G, 21G) 11
- 8 Opisthonotal region with less than 25 pairs of setae (Fig. 11A); tectum broad and usually trispinate (Figs 11C, 39J) 9
- Opisthonotal region with more than 30 pairs of setae (Fig. 58A); tectum produced into a single tapered process (Figs 56C, 58C) 10
- 9 Podonotal region with setae *j1*, *j4*, *z5* and *r3* stout and finely pilose and much longer than the remaining setae; with a pair of large conspicuous circular pores posterolaterally (Fig. 11A); corniculi sessile, plain (Fig. 11E) *Parasitus evertsi* Oudemans (p. 269)
- Podonotal region with setae *j1*, *j4* and *z5* not excessively longer than the remaining setae; circular pores absent (Fig. 39H); corniculi stalked, slender and notched on the inner margins (Fig. 39O) *Porrhostaspis lunulata* Müller (p. 320)
- 10 Large species, idiosoma exceeding 1200  $\mu\text{m}$ ; opisthonotal and opisthogastric setae relatively short, few reaching beyond the bases of the succeeding setae (Fig. 56A, B); setae on palp trochanter arising from strong tubercles (Fig. 56E) *Poecilochirus carabi* G. & R. Canestrini (p. 350)
- Smaller species, idiosoma not exceeding 850  $\mu\text{m}$ ; opisthonotal and opisthogastric setae long, the majority reaching well beyond the bases of the succeeding setae (Fig. 58A, B); palp trochanter lacking strong tubercles (Fig. 58E) *Poecilochirus austroasiaticus* Vitzthum (p. 355)



- 11 Trochanter of pedipalp with two strong tooth-like protuberances ventrally (Fig. 3J); tectum with a strong tapered prominence arising from a broad square base (Fig. 3H)  
*Parasitus coleopratorum* (Linnaeus) (p. 256)
- Trochanter of pedipalp normal; tectum otherwise . . . . . 12
- 12 Tectum trispinate (Figs 6C, 13I) . . . . . 13
- Tectum with prominent median process (Figs 21C, 10H) . . . . . 17
- 13 Anterolateral seta on palp femur strongly bifid . . . . . 14
- Anterolateral seta on palp femur serrated or notched (Figs 53I, 64G) . . . . . 16
- 14 Corniculi deeply cleft (Fig. 13L); tectum with converging long slender tines (Fig. 13I)  
*Parasitus fimetorum* (Berlese) (p. 271)
- Corniculi entire; tines of tectum shorter, not converging (Fig. 8K) . . . . . 15
- 15 Idiosoma c. 600  $\mu\text{m}$  in length; *Z1* and *Z3* stout; *J1*–*J4* each reaching the bases of the succeeding setae (Fig. 6A); spurs on leg II slender, those on the femur greatly reduced and separated (Fig. 6G)  
*Parasitus beta* Oudemans & Voigts (p. 260)
- Idiosoma exceeding 800  $\mu\text{m}$  in length; setae *s5*, *Z1* and *Z3* slender; *J1*–*J4* short not reaching the bases of the succeeding setae (Fig. 8I); spurs on leg II shorter, main spur on the femur strong and contiguous with auxiliary spur (Fig. 8O)  
*Parasitus consanguineus* Oudemans & Voigts (p. 263)
- 16 Leg II with spurs (Fig. 53K); opisthogastric region with two pairs of the posterior setae stout and pilose distally (Fig. 53F); tectum with median tine broad, lateral tines short, pointed (Fig. 53G); dorsum with setae *j1*, *j4*, *z5*, *r3*, *Z1* and *Z3* very stout and pilose distally, remainder very short (Fig. 53A)  
*Gamasodes fimbriatus* Karg (p. 347)
- Leg II without spurs; opisthogastric setae simple; tectum with median tine trifid and pectinate distally (Fig. 64E); dorsum with setae *j4*, *z5*, *r3*, *Z1* and *Z3* pilose distally and slightly stouter than the remaining setae (Figs 64A, 63F)  
*Trachygamasus* (p. 363)
- 17 Large species, idiosoma exceeding 1100  $\mu\text{m}$ ; tectum unusually shaped, comprising a single broad process with a pair of lateral branches (Fig. 10H); corniculi cleft (Fig. 10J)  
*Parasitus copridis* Costa (p. 267)
- Smaller species, idiosoma c. 900  $\mu\text{m}$ ; tectum with median tine flanked on each side basally by dentate cusps (Fig. 21H); corniculi not cleft (Fig. 21J)  
*Parasitus mustelarum* Oudemans (p. 288)
- 18 Corniculi long and slender (Fig. 41M), reaching the midpoint of the palp femur; tectum with strong central tine and dentate base (Fig. 41J); transverse suture between opisthonotal and podonotal regions undulating strongly as in the female (Fig. 41H)  
*Cornigamasus lunaris* (Berlese) (p. 324)
- Corniculi short, not reaching beyond palp trochanter; tectum otherwise; dorsal suture not strongly undulating . . . . . 19
- 19 Idiosoma averaging 750  $\mu\text{m}$  long; podonotal region with setae *j1*, *j4*, *z5* and *r3* stout and distally-pilose, measuring up to 50  $\mu\text{m}$ , remaining setae all very short and fine, maximum length 23  $\mu\text{m}$ ; opisthonotal region with c. 40 pairs of setae of which 4–5 pairs are stout and pilose distally (Fig. 50H); anal setae short (Fig. 50I)  
*Gamasodes spiniger* (Trägårdh) (p. 341)
- Idiosoma averaging 1050–1100  $\mu\text{m}$  long; podonotal region with setae *j1*, *j4*, *z5* and *r3* long, stout and finely pilose, and *z1*, *r2* and *s5* thornlike, the remainder fine; opisthonotal region with c. 30 pairs of setae of which *Z3* are long stout and finely pilose, and *J1*, *Z1*, *S2* and several posterior to *Z3* are thornlike, the remainder being fine (Fig. 17G); postanal seta stout, pilose and up to three times as long as the paranals; restricted to the seashore  
*Parasitus kempersi* Oudemans (p. 280)
- 20 Tectum a variable irregularly-toothed prominence (Figs 24K, 32J, K); restricted to the seashore . . . . . 21
- Tectum otherwise . . . . . 22
- 21 Large species, idiosoma exceeding 2000  $\mu\text{m}$ ; tritosternum with rather short base (Fig. 24I); opisthonotal region with approximately 45 pairs of setae  
*Vulgarogamasus immanis* (Berlese) (p. 292)
- Smaller species, idiosoma less than 1200  $\mu\text{m}$ ; tritosternum with normal long base (Fig. 32I); opisthonotal region with approximately 32 pairs of setae  
*Vulgarogamasus trouessarti* (Berlese) (p. 307)

- 22 Corniculi cleft (Fig. 19M); accessory spur on femur II deeply bifid, V-shaped (Fig. 19N)  
*Parasitus loricatus* (Wankel) (p. 283)  
 – Corniculi entire; accessory spur on femur II single or irregularly formed . . . . . 23
- 23 Palp trochanter with proximal seta unusually stout, arising from a conspicuous protuberance (Fig. 28L, M); tectum a broad triangular plate with a single pair of lateral basal teeth (Fig. 28I) . . . . . *Vulgarogamasus oudemansi* (Berlese) (p. 300)  
 – Setae on palp trochanter normal; tectum otherwise . . . . . 24
- 24 Tectum of characteristic outline (Fig. 26J) . . . . . *Vulgarogamasus kraepelini* (Berlese) (p. 297)  
 – Tectum otherwise . . . . . 25
- 25 Dorsal setae very short, few reaching the bases of the succeeding setae (Figs 52H, 61A) . . . . . 26  
 – Dorsal setae longer, many reaching the bases of the succeeding setae (Figs 31A, 38A) . . . . . 27
- 26 Podonotal setae *r*3 and *z*5 longer than the remaining setae (Fig. 61A), dorsum less than 700  $\mu$ m . . . . . *Poecilochirus davydovae* sp. n. (p. 358)  
 – Setae *r*3 and *z*5 not conspicuously longer than the remaining setae (Fig. 52H), dorsum more than 750  $\mu$ m . . . . . *Gamasodes bispinosus* (Halbert) (p. 345)
- 27 Tectum typically trispinate although the central prong may be rudimentary (Figs 34C, D, 31C) . . . . . 28  
 – Tectum otherwise (Figs 16F, 22C, D) . . . . . 31
- 28 Gnathosoma with a pair of small rounded protuberances lying inwards from the bases of the palpcoxal setae (Fig. 34G) . . . . . 29  
 – Venter of gnathosoma without protuberances . . . . . 30
- 29 Tarsus II with a strong apically-directed spine (Fig. 34H, I); fixed digit of chelicera with a tooth-like projection at its base (Fig. 34E); large species, idiosoma ranging from 1350–1660  $\mu$ m . . . . . *Eugamasus magnus* (Kramer) (p. 310)  
 – Tarsus II with strong setae only (Fig. 35M); fixed digit of chelicera more slender, without a tooth-like projection at its base (Fig. 35J); smaller species, idiosoma ranging from 1150–1350  $\mu$ m . . . . . *Eugamasus berlesei* Willmann (p. 313)
- 30 Large species, idiosoma exceeding 1500  $\mu$ m; tectum with centre prong considerably longer than lateral prongs (Fig. 38J); anal setae short, subequal (Fig. 38B) . . . . . *Eugamasus crassitarsis* (Halbert) (p. 318)  
 – Small species, idiosoma not exceeding 550  $\mu$ m; tectum trispinate, but the centre prong may be rudimentary (Fig. 31C); postanal seta at least twice as long as the paranals (Fig. 31B) . . . . . *Vulgarogamasus remberti* (Oudemans) (p. 304)
- 31 Femur II with main spur robust and directed apically, accessory spur blunt (Fig. 16I); tectum narrow and with three to five teeth on its anterior margin (Fig. 16F) . . . . . *Parasitus insignis* (Holzmann) (p. 279)  
 – Femur II with main and accessory spurs projecting at right angles to the segment (Fig. 22H); tectum a broad triangular plate with a pair of lateral teeth (Fig. 22C, D) . . . . . *Vulgarogamasus burchanensis* (Oudemans) (p. 290)

### Key to females

- 1 Division between sternal and metasternal shields transverse, sometimes obscure (Fig. 64D); lateral lobes of pulvilli acuminate (Fig. 64I) . . . . . *Trachygamasus* (p. 363)  
 – Division between sternal and metasternal shields oblique (Figs 38I, 51B), occasionally indistinct (Fig. 15H); ambulacra without such acute lobes . . . . . 2
- 2 Opisthogastric shield with 20 or more pairs of setae (Figs 45B, 47B); normally associated with *Bombus* spp. and their nests . . . . . 3  
 – Opisthogastric shield with usually not more than 12 pairs of setae (Figs 38I, 41I) . . . . . 6
- 3 Opisthogastric shield with less than 25 pairs of setae (Fig. 45B) . . . . . *Parasitellus crinitus* (Oudemans) (p. 331)  
 – Opisthogastric shield with more than 30 pairs of setae (Fig. 43B) . . . . . 4
- 4 Opisthogastric shield with about 16 long and finely pilose setae situated medially, the remainder, together with those on the surrounding membrane, short and simple (Fig. 49B) . . . . . *Parasitellus talparum* (Oudemans) (p. 337)  
 – Opisthogastric setae homogeneous . . . . . 5

- 5 Dorsal and ventral setae simple, generally long and passing the bases of the succeeding setae (Fig. 47A, B); tectum trispinate (Fig. 47C) *Parasitellus ignotus* (Vitzthum) (p. 334)
- Dorsal and ventral setae considerably shorter, stouter and pilose (Fig. 43A, B); tectum bispinate (Fig. 43C) *Parasitellus fucorum* (De Geer) (p. 228)
- 6 Podonotal setae *j1*, *j4*, *z5* and *r3* frequently stout and pilose and clearly longer than the remaining setae (Figs 11G, 14A) 7
- Podonotal setae relatively homogeneous (Figs 36A, 56H), or with at least half longer than the remainder (Figs 15G, 40A) 17
- 7 Tectum a long tapered prong arising from a denticulate base (Figs 4C, 41J) 8
- Tectum trispinate, rarely bispinate 9
- 8 Opisthonotal shield with 12 pairs of setae; corniculi long and slender (Fig. 41M), reaching the midpoint of the palp femur, opisthogastric shield with 7 pairs of setae (Fig. 41I) *Cornigamasus lunaris* (Berlese) (p. 324)
- Opisthonotal shield with about 35 pairs of setae; corniculi normal (Fig. 4F), not reaching beyond palp trochanter; opisthogastric shield with 10–12 pairs of setae (Fig. 4B) *Parasitus coleopratorum* (Linnaeus) (p. 256)
- 9 Genital shield conspicuously broad and shallow, abruptly tapering anteriorly; presternal shields granular, broad and well developed (Fig. 54C); short dorsal setae rarely exceeding 25  $\mu$ m (Fig. 51A) 10
- Genital shield narrower and deeper; presternal shields less well developed, may be rudimentary or absent (Figs 11H, 18A); dorsal setae never as short 11
- 10 Found exclusively in seashore debris *Gamasodes fimbriatus* Karg (p. 347)
- Found in vegetation, compost, nests of mammals and birds *Gamasodes spiniger* (Trägårdh) (p. 341)
- 11 Anterolateral seta on palp femur deeply bifurcate (Fig. 14F) 12
- Anterolateral seta on palp femur not bifurcate (Fig. 18E) 14
- 12 Posterior hypostomatic setae straight, externals almost twice the length of the internals (Fig. 9F); sternal setae I forked distally and arising from small platelets (Fig. 9B); opisthogastric shield with ten pairs of setae *Parasitus consanguineus* Oudemans & Voigts (p. 263)
- Posterior hypostomatic setae long and convoluted (Fig. 14G); sternal setae simple; opisthogastric shield with eight pairs of setae (Fig. 14B) 13
- 13 Podonotal shield over 450  $\mu$ m long; endogynium as in figure 14C *Parasitus fimetorum* (Berlese) (p. 271)
- Podonotal shield less than 370  $\mu$ m long; endogynium as in figure 7B *Parasitus beta* Oudemans & Voigts (p. 260)
- 14 Opisthonotal shield with usually 17–20 pairs of setae; podonotal shield with a pair of large conspicuous pores posterolaterally (Fig. 11G); opisthogastric shield with seven pairs of setae (Fig. 11H) *Parasitus evertsi* Oudemans (p. 269)
- Opisthonotal shield with more than 25 pairs of setae; podonotal shield without conspicuous pores posterolaterally; opisthogastric shield with eight or nine pairs of setae 15
- 15 Opisthonotal shield of large proportions, completely covering the postero-dorsal region and extending ventrally, and bearing about 75 pairs of setae (Fig. 10L) *Parasitus copridis* Costa (p. 267)
- Opisthonotal shield of normal proportions, not extending to the ventral surface, and bearing approximately 30 pairs of setae (Fig. 21L) 16
- 16 Tectum with three subequal prongs (Fig. 18B, C); presternal shields absent; opisthogastric shield with eight pairs of setae of which the two postero-marginal pairs are stout and pilose (Fig. 18A); found exclusively on the seashore *Parasitus kempersi* Oudemans (p. 280)
- Tectum with median prong long and blunt, lateral prongs shorter and denticulate (Fig. 21N); presternal shields small and triangular; opisthogastric shield with eight pairs of setae of which one postero-marginal pair is stout and pilose (Fig. 21M) *Parasitus mustelarum* Oudemans (p. 288)
- 17 Tectum trispinate, with lateral prongs well developed and their bases smooth (Figs 27D, 37C, 38J) 18
- Tectum otherwise (Figs 25D, 52N, 56J) 27



- 18 Opisthonotal shield with more than 35 pairs of setae . . . . . 19
- Opisthonotal shield with less than 30 pairs of setae . . . . . 21
- 19 Opisthonotal shield with about 60 pairs of setae; posterior margin of podonotal shield with four pairs of setae (Fig. 37A) . . . . . *Eugamasus cavernicola* (Trägårdh) (p. 316)
- Opisthonotal shield with about 50 pairs of setae; posterior margin of podonotal shield with usually five pairs of setae (Fig. 36A) . . . . . 20
- 20 Podonotal shield over 750  $\mu\text{m}$  long; tectum as in figure 38J . . . . . *Eugamasus crassitarsis* (Halbert) (p. 318)
- Podonotal shield less than 680  $\mu\text{m}$  long; tectum as in figure 36C . . . . . *Eugamasus berlesei* Willmann (p. 313)
- 21 Genital shield trispinate anteriorly, unusually long and extending to the level of coxae II (Fig. 40B) . . . . . *Porrhostaspis lunulata* Müller (p. 320)
- Genital shield not trispinate, of normal proportions, not reaching beyond the midpoint of coxae III (Fig. 29B) . . . . . 22
- 22 Opisthogastric shield with 8 pairs of setae (Fig. 15H); anterolateral seta on palp femur deeply bifurcate (Fig. 15L) . . . . . *Parasitus hyalinus* (Willmann) (p. 277)
- Opisthogastric shield with nine or more pairs of setae; anterolateral seta on palp femur serrated (Figs 16N, 20E) . . . . . 23
- 23 Peritreme not reaching coxa I; endogynium with medially directed hornlike processes (Fig. 16K); trochanter IV with small dorsal protuberance (Fig. 16P) . . . . . *Parasitus insignis* (Holzmann) (p. 279)
- Peritreme extending to coxa I; endogynium without hornlike processes; trochanter IV without protuberance . . . . . 24
- 24 Tectum with median prong shorter than laterals (Fig. 27D) . . . . . 25
- Tectum with median prong stouter and longer than laterals (Fig. 20C) . . . . . 26
- 25 Podonotal shield over 390  $\mu\text{m}$  long; genital shield with a pair of lateral horns; sternal shield strongly sclerotized and usually indented posteriorly (Fig. 27C) . . . . . *Vulgarogamasus kraepelini* (Berlese) (p. 297)
- Podonotal shield approximately 300  $\mu\text{m}$  long; genital shield without lateral horns; sternal shield weakly sclerotized, not indented posteriorly . . . . . *Vulgarogamasus remberti* (Oudemans) (p. 304)
- 26 Dorsal setae long, mostly reaching beyond the bases of the succeeding setae (Fig. 29A); podonotal shield less than 570  $\mu\text{m}$  long; opisthogastric shield with 10 or 11 pairs of setae; genital shield with lateral horns (Fig. 29B); sterno-genital shields with weak reticulations . . . . . *Vulgarogamasus oudemansi* (Berlese) (p. 300)
- Dorsal setae short, few reaching the bases of the succeeding setae (Fig. 20A); podonotal shield more than 630  $\mu\text{m}$  long; opisthogastric shield with nine pairs of setae; genital shield without lateral horns; sterno-genital shields conspicuously ornamented (Fig. 20B) . . . . . *Parasitus loricatus* (Wankel) (p. 283)
- 27 Opisthonotal shield pear shaped and considerably narrower than the podonotal shield which is tapered markedly behind setae *r*3 (Fig. 33A); restricted to the seashore . . . . . *Vulgarogamasus trouessarti* (Berlese) (p. 307)
- Opisthonotal shield not pear shaped and not conspicuously narrower than the podonotal (Figs 25A, 56H) . . . . . 28
- 28 Leg II with spurs, especially on the femur and genu . . . . . 29
- Leg II devoid of spurs . . . . . 30
- 29 Femur II with two slender finger-like spurs and genu II with one (Fig. 52P); tectum trispinate with lateral margins deeply denticulate (Fig. 52N) . . . . . *Gamasodes bispinosus* (Halbert) (p. 345)
- Femur, genu and tibia II each with one spur (Fig. 61K); tectum narrow with a trispinate tip (Fig. 61H) . . . . . *Poecilochirus davydovae* sp. nov. (p. 358)
- 30 Opisthonotal shield with approximately 40 pairs of setae; postanal seta considerably longer than the paranals (Fig. 56I) . . . . . 31
- Opisthonotal shield with less than 30 pairs of setae; anal setae subequal (Fig. 23B) . . . . . 32
- 31 Podonotal shield more than 650  $\mu\text{m}$  long; opisthonotal shield more than 850  $\mu\text{m}$  long; tectum finely tapered anteriorly with angular serrated margins (Fig. 56J) . . . . . *Poecilochirus carabi* G. & R. Canestrini (p. 350)

- Podonotal shield less than 550  $\mu\text{m}$  long; opisthonotal shield less than 600  $\mu\text{m}$  long; tectum tapering with its apex flanked by a pair of small prongs (Fig. 59C)  
*Poecilochirus austroasiaticus* Vitzthum (p. 355)
- 32 Large species, podonotal shield more than 1200  $\mu\text{m}$  long, opisthonotal shield more than 800  $\mu\text{m}$  long; restricted to the seashore  
*Vulgarogamasus immanis* (Berlese) (p. 292)
- Small species, podonotal and opisthonotal shields each less than 400  $\mu\text{m}$  long  
*Vulgarogamasus burchanensis* (Oudemans) (p. 290)

### Genus *PARASITUS* Latreille

*Parasitus* Latreille, 1795. *Magazin encycl.* 4 (13): 19.

*Carpais* Latreille, 1796. (In part). *Précis des caractères génériques des insectes disposés dans un ordre naturel*. Abrive: 184.

*Gamasus* Latreille, 1802. *Histoire naturelle, générale et particulière des crustacés et des insectes*. Paris, 3: 64.

*Coleogamasus* Tichomirov, 1969. *Zool. Zh.* 48: 1470.

TYPE SPECIES. *Acarus coleoptratorum* Linnaeus, 1758.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields. Setae  $z5$  of dorsal hexagon usually markedly different in form from  $j5$  and  $j6$ . Tritosternum of male absent or variously modified, or if biramous, then base closely associated with genital orifice; tritosternum of female and deutonymph normal. Junction between sternal and metasternal shields of female oblique. Genital shield of female triangular or subtriangular. Opisthogaster with rarely more than 30 pairs of setae. Seta  $al$  of palp femur bifid or with one or more distinct slender processes; setae  $al_1$  and  $al_2$  of palp genu entire, spatulate or setiform. Male chelicerae symmetrical. Corniculi short, entire or bifid, rarely otherwise modified. Legs of deutonymph and female without spurs, at most with strong setae; only leg II of male spurred. Lobes of pulvilli normal, rounded.

### *Parasitus coleoptratorum* (Linnaeus)

(Figs 3A–M; 4A–F)

*Acarus coleoptratorum* Linnaeus, 1758: 618.

*Gamasus* (*Gamasus*) *coleoptratorum* (Linn.) sensu Latreille, Berlese, 1906: 155.

*Gamasus coleoptratorum*: Hull, 1917: 103. Non Berlese, 1892b: Fasc. 69, T.7 = *Gamasus distinctus* Berl., 1904a.

*Parasitus coleoptratorum*: Oudemans, 1908: 28. Costa, 1963: 27, Micherdzinski, 1969: 393. Karg, 1971: 446. Evans & Till, 1979: 210.

*Eugamasus celer* (C. L. Koch, 1835) sensu Holzmman, 1969: 8.

*Parasitus* (*Coleogamasus*) *celer*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 85, 89.

**DEUTONYMPH.** The reticulated dorsal shields are strongly sclerotized and generally rich yellow to brown in colour. The podonotal shield (600–754  $\mu\text{m}$  long  $\times$  700–754  $\mu\text{m}$  wide) bears 20 pairs of setae of which  $j1$ ,  $j4$ ,  $z5$  and  $r3$  are long, stout and pilose distally, the remainder being very short and simple, with  $s2$  situated off the shield. Setae  $j1$  and  $z1$  are situated on a prominent transverse granular band (Fig. 3A). The opisthonotal shield (370–415  $\mu\text{m}$  long  $\times$  620–672  $\mu\text{m}$  wide) bears 16 pairs of setae of which 15 pairs are short and simple and  $Z3$  are long (*c.* 125  $\mu\text{m}$ ), stout and pilose distally. The surrounding membrane bears dorsally on each side between 40 and 50 very short setae.

The tritosternum has a narrow base and pilose laciniae. The sternal shield (384–410  $\mu\text{m}$  long) is reticulated with a pale anterior transverse strip, the setae normally appear simple, *st*. I are occasionally finely pilose. The presternal shields are frequently absent or barely discernible, but when present they are small (Fig. 3B). The oval anal shield bears the normal three setae, the paranals being the longest. The stigma is situated opposite the posterior margin of coxa III and the peritreme extends anteriorly to the level of coxa I. The opisthogastric setae are all simple.

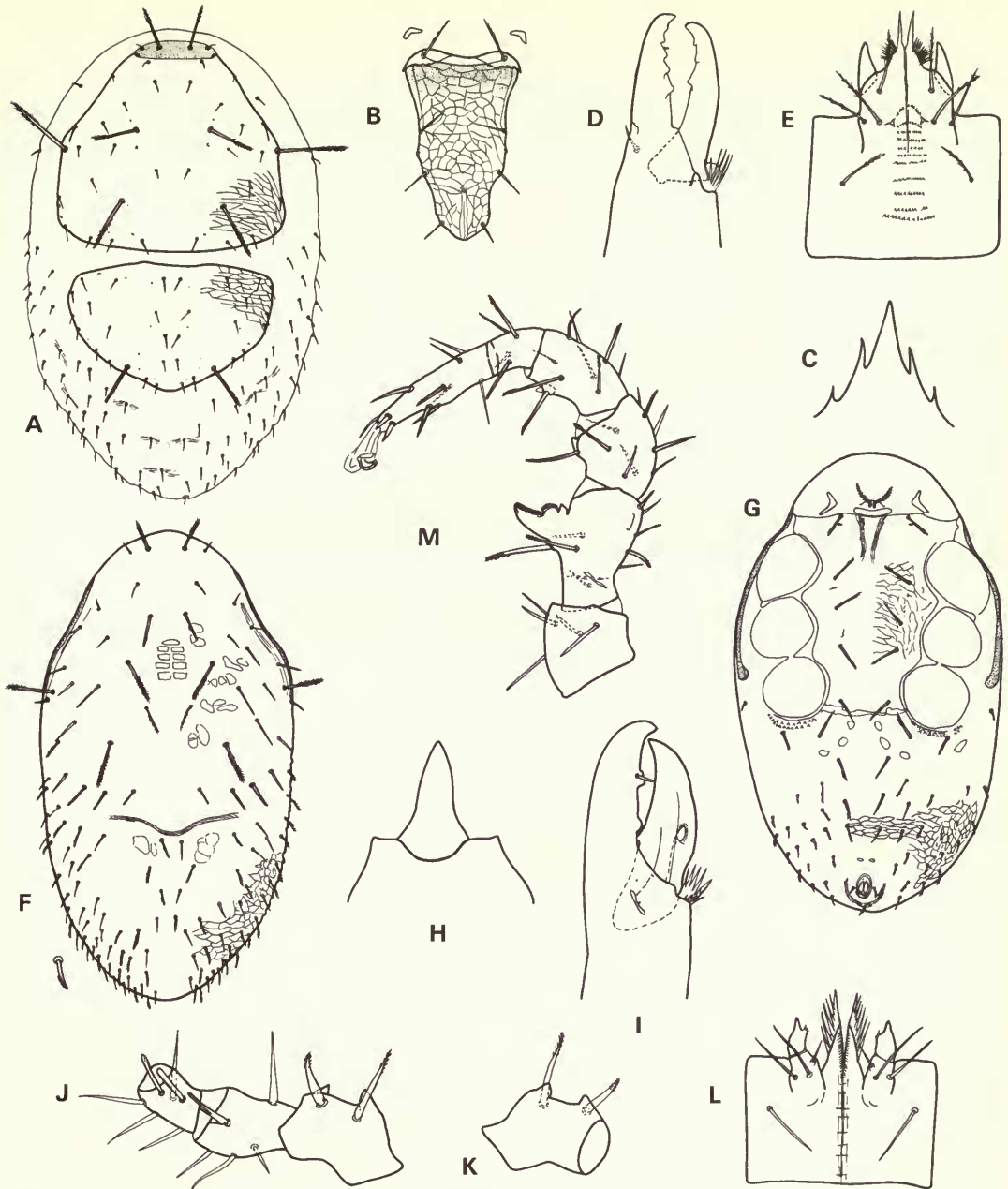


Fig. 3 *Parasitus coleopratorum* (L.), deutonymph—A dorsum; B sternal shield; C tectum; D chelicera; E venter of gnathosoma: male—F dorsum; G venter; H tectum; I chelicera; J palp trochanter, femur and genu; K palp trochanter; L venter of gnathosoma; M left leg II.

The five-pointed tectum appears to show very little variation (Fig. 3C). The chelicera is as in figure 3D, whilst the anterolateral setae of the palp femur and genu are as in the female (Fig. 4E). The corniculi and venter of the gnathosoma are as in figure 3E. All legs bear a number of finely pilose setae, mainly on the proximal segments, whilst on legs III and IV the setae are markedly stouter than on legs I and II. The pulvilli are normal.



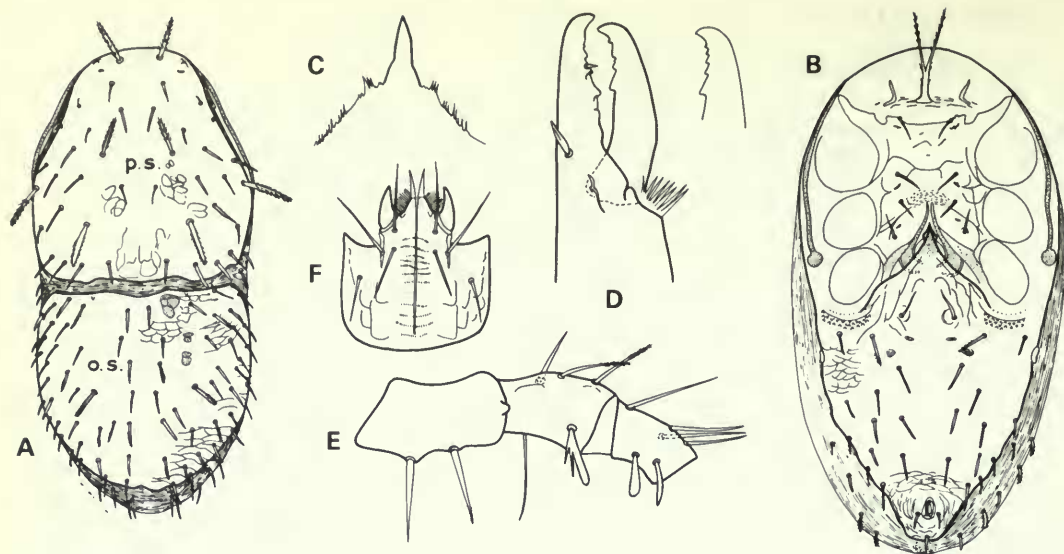


Fig. 4 *Parasitus coleoptratorum* (L.), female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma. p.s., podonotal shield, o.s., opisthonal shield.

**MALE.** The dorsal shield (1260–1320  $\mu\text{m}$  long  $\times$  720–780  $\mu\text{m}$  wide) is entire with a transverse undulating suture. It is mainly reticulated, especially around the margins, whilst medially are isolated granular areas (Fig. 3F). The podonotal region bears about 24 pairs of setae, in the specimen figured the left *z3* is lacking. Setae *j1*, *j4*, *z5* and *r3* are the longest and are stout and finely pilose. Others, for example *j3* and *s5*, are also stouter than the remainder which are predominately short, curved and blade-like as shown in the inset. The opisthonal region bears about 37–45 setae on each side, mainly located in the marginal area.

The tritosternum comprises two pilose laciniae which arise from a slight protuberance anterior to the genital lamina (Fig. 3G). The sternogenital setae are simple, whilst the paired paranal and single postanal setae are stout, slightly curved and of similar length to the majority of the posterior opisthogastric setae. The median and anterior opisthogastric setae approach the length of the sternogenitals. The stigma is opposite the posterior margin of coxa III and the peritreme extends anteriorly to the level of coxa I. A double row of small teeth is situated immediately posterior to coxa IV.

The tectum, which appears to show little variation, comprises a tapered prominence arising from a broad squarish base (Fig. 3H). The chelicera is as in figure 3I: the movable digit is broad and curved with a single tooth midway, whilst the fixed digit bears two teeth. The palp trochanter, femur and genu are shown in figure 3J. The trochanter bears two prominent tooth-like protuberances ventrally and the anterior seta is stout (Figs 3J, K). The anterolateral seta on the femur is trispinate whilst the two anterolaterals on the genu are spatulate. The venter of the gnathosoma is as in figure 3L. The corniculi, which are stalked and broad at their bases, bear an excrescence midway on the inner margin. The anterior hypostomatic setae are short and extremely slender whilst the posterior hypostomatic and palpcoxal setae are stout and long. Between eight and 12 rows of hypognathal denticles are normally apparent. Leg II is shown in detail in figure 3M. Many of the leg setae are very finely pilose at their tips and often along one margin.

**FEMALE.** The podonotal shield (720–792  $\mu\text{m}$  long  $\times$  660–768  $\mu\text{m}$  wide) bears 21 pairs of setae of which *j1*, *j4*, *z5* and *r3* are longer and stouter than the remainder and are finely pilose (Fig. 4A). As in the male, the shorter setae are mainly curved and pilose distally. The opisthonal

shield (650–700  $\mu\text{m}$  long  $\times$  708–816  $\mu\text{m}$  wide) bears approximately 34–36 pairs of setae of which Z3 are the stoutest. The arrangement of setae on this shield is apparently symmetrical, but it is not easy to be certain if any of the marginal setae have been detached due to the crenate border concealing the setal bases. The small area of interscutal membrane posterior to the opisthonotal shield bears only about five pairs of setae.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of L-shaped presternal shields (Fig. 4B). The sternal and metasternal shields are granular and the setae are simple. The genital shield is sharply pointed anteriorly. The opisthogastric shield tapers somewhat irregularly and bears between 10 and 12 pairs of setae, normally arranged symmetrically, but varying in number depending on whether or not the laterals are on or off the shield. The three anal setae are of approximately equal length. The lateral membrane bears few setae. The stigma is situated opposite the posterior margin of coxa III and the peritreme extends anteriorly to the level of coxa I.

The tectum has a single strong tapered prominence similar to the male, but this arises from a sharply toothed tapered base (Fig. 4C). The chelicera is as in figure 4D, with the dentition of the movable digit of the second chelicera of the same specimen inset. The palp trochanter, genu and femur are shown in figure 4E and the venter of the gnathosoma in figure 4F. Many of the leg setae are finely pilose at their tips and along one margin. No characteristic setal formations are present.

**MATERIAL EXAMINED.** 218 samples – 9 PNN, c. 1650 DNN, 53  $\sigma\sigma$ , 67  $\phi\phi$ .

ENGLAND: Isles of Scilly, Cornwall (mainland), Devon, Dorset, Gloucestershire, Hampshire, Isle of Wight, Surrey, Sussex, Kent, London, Essex, Middlesex, Hertfordshire, Buckinghamshire, Cambridgeshire, Norfolk, Huntingdonshire, Worcestershire, Leicestershire, Lincolnshire, Derbyshire, Cheshire, Lancashire, Manchester, Westmorland, Cumberland, Yorkshire, Northumberland, Durham.

WALES: Pembrokeshire, Radnorshire, Cardiganshire, Montgomeryshire, Merionethshire, Caernarvonshire, Anglesey.

SCOTLAND: Roxburghshire/Midlothian borders, Dunbartonshire, Kirkcubrightshire, Argyllshire, Angus, Outer Hebrides, Inner Hebrides, Shetland, Fair Isle.

IRELAND: Cork, Kildare, Westmeath, Meath, Clare, Galway, Sligo.

*Parasitus coleoptratorum* is possibly the most common European member of the genus and is distributed throughout the British Isles. The deutonymphs are well known as paraphages of Coleoptera (Hull, 1918, Hyatt, 1959) and of the 218 samples examined in the present work 107 are from beetles of the following genera: *Geotrupes*, *Onthophagus*, *Typhaeus*, *Aphodius*, *Nicrophorus* and *Hister*. The adults are found much less frequently than the deutonymphs and they are confined (occasionally in association with deutonymphs) mainly to compost, manure (Hull, 1918) and rich humus, including rotting seaweed, as well as the nests of small mammals and occasionally birds. Only one instance of adults and deutonymphs from a beetle has come to my notice, viz. 3 DNN, 1  $\sigma$ , 1  $\phi$  ex *Geotrupes spiniger* (Marshall), Heddon-on-the-Wall, Newcastle-upon-Tyne, 2 October 1969, coll. M. L. Luff. The only specimen examined from a non-coleopterous insect is a single deutonymph in the Hull Collection from a caterpillar of the puss-moth *Cerura vinula* (L.), Bowden, Cheshire, 4 August 1917, coll. T. A. Coward. A single deutonymph has been examined from bat dung, Bryanston, Devon, 1977.

**DISTRIBUTION.** Previous British records are from the Tyne Province ('common everywhere', Hull, 1918), Co. Mayo and Co. Dublin (Halbert, 1915, 1920), the Inner Hebrides (Bertram, 1939), Hertfordshire (Hyatt, 1956), Isles of Scilly (Evans, 1957b), Dorset and the Isles of Scilly (Hyatt, 1959), Devon (Mean-Briggs & Hughes, 1966) and Cumberland (Turk, 1972). Turk (1967) records this species from caves without giving a locality and specimens have not been examined by me. Hazelton (1967a) records it from a cave in Somerset and from a mine in Cumberland, the latter being the same record as given by Turk (1972).

It is recorded from Iceland (Sellnick, 1928, 1940), the Faeroes (Trägårdh, 1931), Finland (Nordberg, 1936, Willmann, 1938c), Holland (Oudemans, 1896, 1900, 1902b, 1903a 1905b, 1908), Belgium (van Daele & Heungens, 1974, 1975), Germany (Koch, 1835, Voigts & Oudemans, 1904, 1905, Vitzthum, 1927, 1930a, Karg, 1971), Austria (Franz, 1943, Leitner, 1946), Switzerland (Schweizer, 1922, 1949, 1961), Italy (Berlese, 1906, 1913, Valle, 1955), Hungary (Valle, 1955), Czechoslovakia (Müller, 1860, Willmann, 1954), Poland (Schweizer, 1926, Willmann, 1956, Micherdzinski, 1969), Western Siberia (Davydova, 1969, 1976), and also from Israel (Shulov, 1957, Costa, 1963, 1966) and Chile (Berlese & Leonardi, 1902).

***Parasitus beta* Oudemans and Voigts**  
(Figs 5A–F; 6A–G; 7A–F)

*Parasitus beta* Oudemans & Voigts, 1904 in Voigts & Oudemans, 1904: 652; 1905: 219. Type examined.

*Parasitus eta* Oudemans & Voigts, 1904 sensu Karg, 1965: 303, fig. 59b, ♀ only; 1971: 425, ♀ only. *Parasitus eta* Ouds. & Vgts., 1904 (DN only described) = *P. fimetorum* Berlese, 1904, q.v.

Several species have been described, most as deutonymphs only, which show a close resemblance to *Parasitus fimetorum* Berlese, 1904. Most of these fall within the size range examined for that species, but some are considerably smaller. The main similarities are, in the deutonymph, the dorsal chaetotaxy, and in the female, the contorted posterior hypostomatic setae and the close proximity to each other of sternal setae I and the shape of the genital shield. However, as far as I can ascertain following comparison with the types of several of these species, viz. *Parasitus eta*, *beta* and *alpha*, all Oudemans & Voigts, 1904, and *Gamasus distinctus* Berlese, 1904\* and by reference to the figures of *Parasitus noll* Karg, 1965, and *Gamasus neglectus* Berlese, 1904, the only species which has dorsal setae *s5* clearly stout like *z5* (especially in the deutonymph) is *Parasitus beta*.

The 65 deutonymphs, 4 males and 8 females that I am assigning to this taxon are from 15 samples, several of which contained no other *Parasitus*, whilst the remainder contained *Parasitus* species that could not be confused with the present one.

**DEUTONYMPH.** The dorsal shields are generally weakly sclerotized and entirely reticulated (Fig. 5A). The podonotal shield (300–336 µm long × 290–384 µm wide) bears 20 pairs of setae, *s2* being situated off the shield. Setae *j1*, *j4*, *z5*, *s5*, *s6* and *r3* are stouter than the remaining setae which are very fine. The longest and stoutest, *r3* (c. 100 µm), are also finely pilose. The opisthonotal shield (190–240 µm long × 250–360 µm wide) bears 15 pairs of setae of which three, *J5*, *Z3* and *S4*, are clearly stouter than the other marginal setae. The inner setae are very fine and slender. The setae on the posterior membrane are intermediate in thickness.

The tritosternum has a narrow base and pilose laciniae. The presternal shields are weakly sclerotized (Fig. 5B). The sternal shield (204–240 µm long) is finely reticulated and the setae are simple. The reticulated anal shield is oval and the three setae are simple. The opisthogastric setae are simple and, as on the dorsum, the median setae are the finest. The peritreme extends to coxa I.

The tectum is trispinate with the centre prong usually giving the appearance of being damaged distally (Fig. 5C). The chelicera is as in figure 5D: the movable digit measures c. 45 µm. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 5E, and the venter of the gnathosoma in figure 5F. The leg setae are simple and all of similar form. Tarsus IV bears dorsally a conspicuous erect seta c. 120 µm in length.

**MALE.** The dorsum (580–600 µm long × 340 µm wide) is entire and with a transverse suture (Fig. 6A). It is completely reticulated but not strongly sclerotized. The podonotal region bears 21 pairs of setae of which *j1*, *j4*, *z5*, *s5* and *r3* are the stoutest. The remainder are slender. The opisthonotal region bears approximately 30 pairs of setae of which *Z1* and *Z3* are the stoutest and those towards the margins are almost as stout, whilst *J1*–*J4* are slender.

\*Cited by Karg (1971: 447) as *Parasitus distructus* (Berlese).



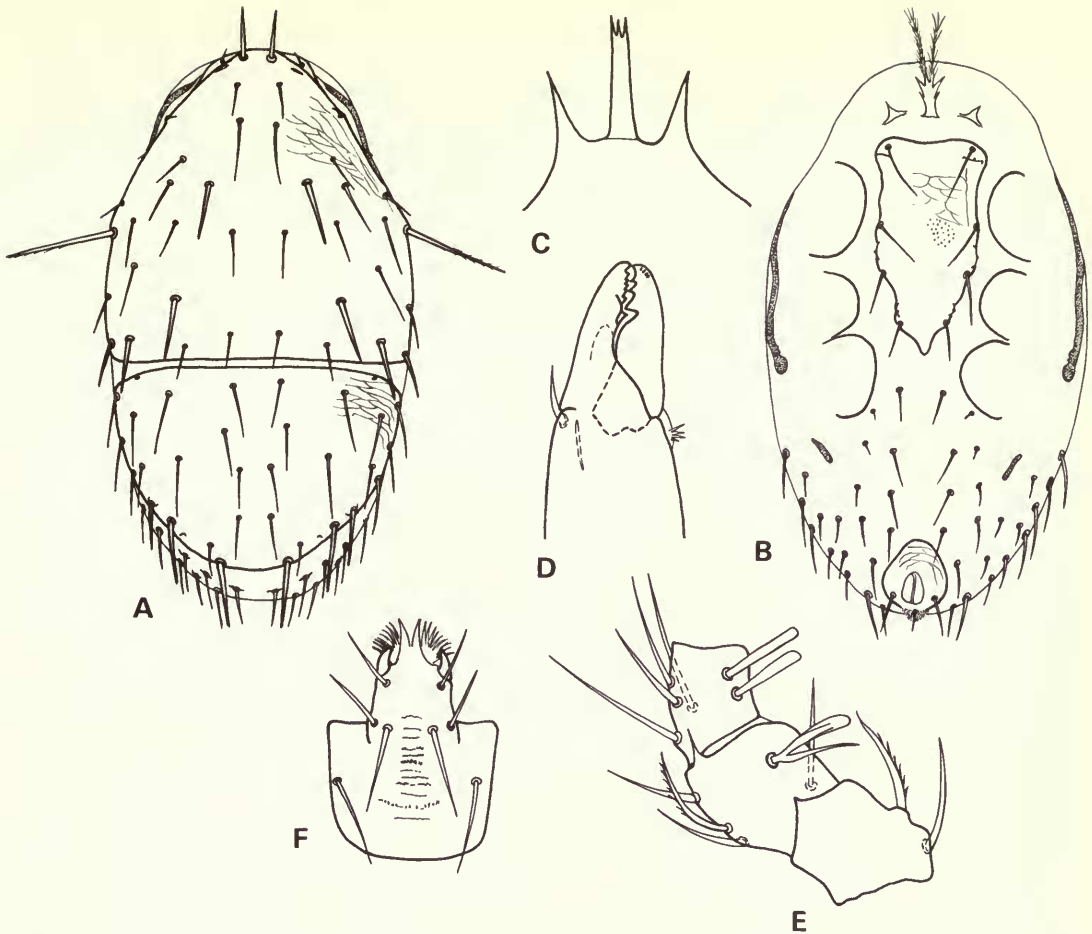


Fig. 5 *Parasitus beta* Oudemans & Voigts, deutonymph – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

The tritosternum, which measures *c.* 45  $\mu\text{m}$  in total length, has very fine slender laciniae and a rudimentary base (Fig. 6B). The ventral sclerotization and chaetotaxy are little different from those of *P. fimetorum*, although the more posterior setae are shorter. The peritreme extends to coxa I.

The tectum is trispinate, the centre spine being slightly the longest (Fig. 6C). The chelicera is shown in figure 6D, and the palp trochanter, femur and genu in figure 6E. The corniculi are short, pointed and strongly stalked and the gnathosomal setae are simple (Fig. 6F). The leg setae all appear to be simple and are generally rather strong relative to the overall weakness of sclerotization. Leg II is shown in detail in figure 6G. In one specimen from Ireland the right leg II lacks all spurs.

**FEMALE.** The podonotal shield (350–360  $\mu\text{m}$  long  $\times$  370  $\mu\text{m}$  wide) is finely reticulated and bears 21 pairs of setae of which *j1*, *j4*, *z5* and *r3* (*c.* 100  $\mu\text{m}$ ) are longer and stouter than the remainder and are finely pilose (Fig. 7A). Seta *s5* is also stout but not long. The opisthonotal shield (330–350  $\mu\text{m}$  long  $\times$  360–370  $\mu\text{m}$  wide) is also reticulated and bears 26 pairs of setae of which *Z1*, *Z3* and *J5* are the stoutest and are finely pilose at least distally. The lateral setae are generally stouter than *J1*–*J4*.

The tritosternum has a narrow base and pilose laciniae. It is flanked by weakly sclerotized presternal shields (Fig. 7B). The sternal shield is particularly weakly sclerotized. The sternal setae are stouter than the metasternals and genitals. The genital shield is strongly pointed

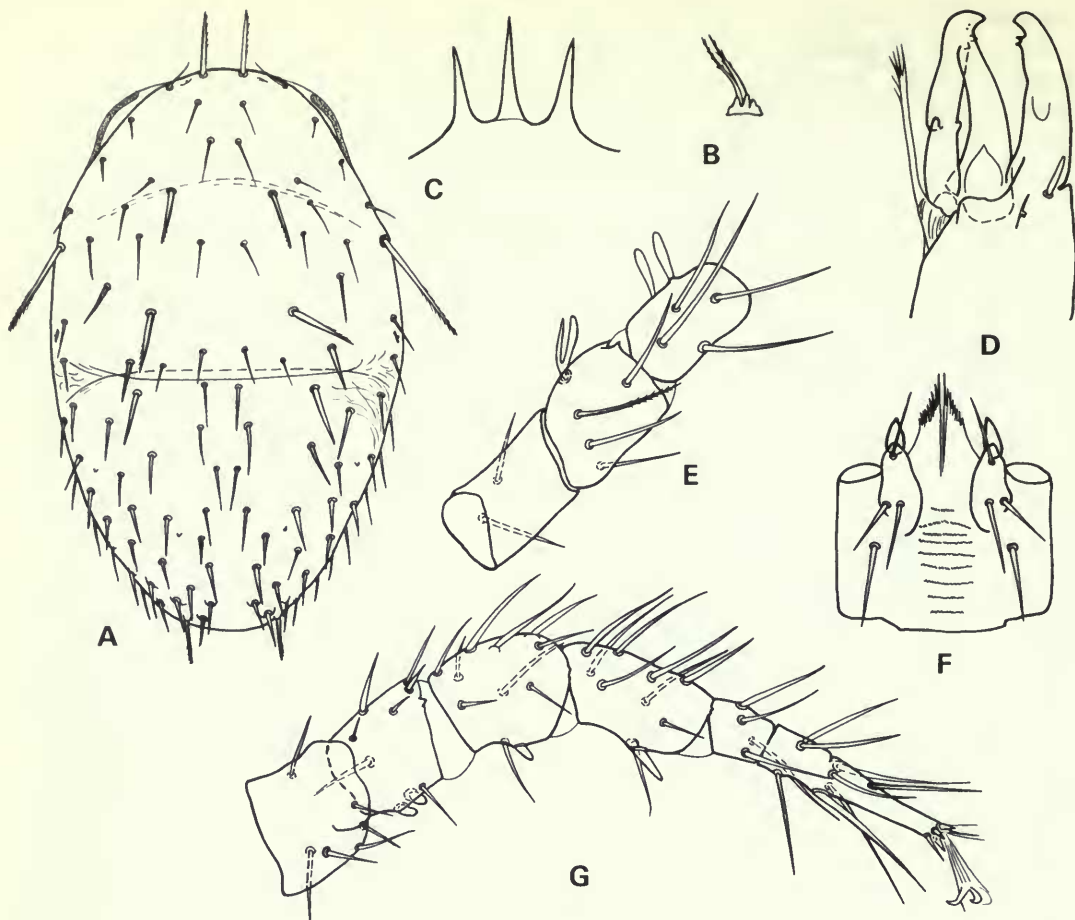


Fig. 6 *Parasitus beta* Oudemans & Voigts, male – A dorsum; B tritosternum; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G leg II.

anteriorly, whilst posteriorly it merges with the weakly sclerotized but reticulated opisthogastric shield. The endogynium shows a mushroom-shaped process. The lateral margins of the opisthogastric shield are sometimes irregularly formed and of the eight pairs of setae, two marginal pairs are conspicuously long and stout. The anal setae are simple. The peritreme extends to coxa I.

The tectum is trispinate with the centre prong multifid (Fig. 7C). The chelicera is shown in figure 7D, and the chaetotaxy of the palp trochanter, femur and genu in figure 7E. The corniculi are short and tapered and the posterior hypostomatic setae are long and contorted (Fig. 7F). The leg setae are mainly long and fine and all appear to be simple.

**MATERIAL EXAMINED.** 15 samples – 65 DNN, 4 ♂♂, 8 ♀♀.

ENGLAND: Cornwall, Somerset, Gloucestershire, Surrey, Kent, Cambridgeshire, Suffolk, Northamptonshire, Leicestershire.

SCOTLAND: Isle of Muck.

IRELAND: Kildare, Westmeath.

Most samples are from grassland, although a female and four deutonymphs from Cornwall are from dried seaweed, seven deutonymphs from Kent are from *Aphodius* sp. (Coleoptera) and a single deutonymph from the Isle of Muck is from *Apodemus sylvaticus* (L.).

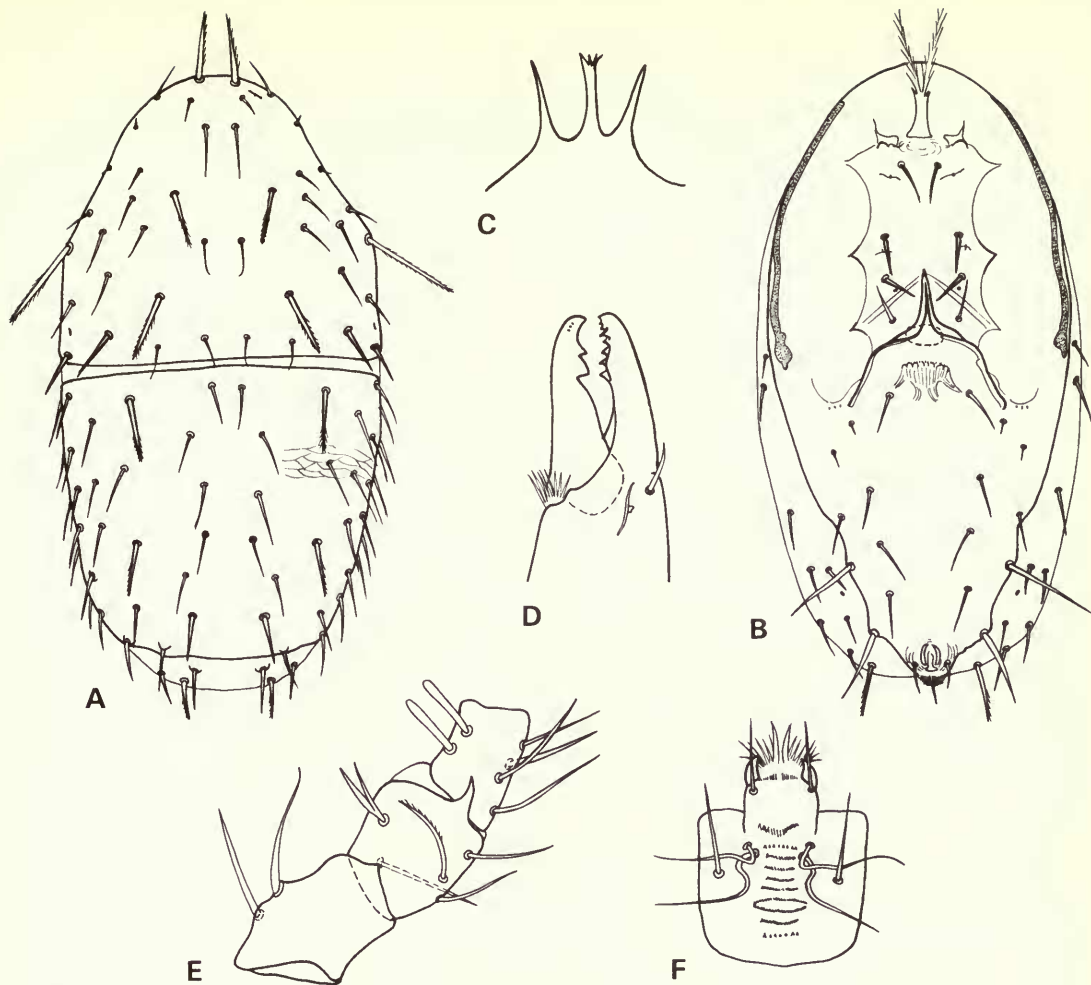


Fig. 7 *Parasitus beta* Oudemans & Voigts, female—A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

**DISTRIBUTION.** This species has not been recorded from the British Isles. Previous records are from Germany (Voigts & Oudemans, 1904, 1905, Karg, 1965, 1971, Micherdzinski, 1969).

***Parasitus consanguineus* Oudemans & Voigts**  
(Figs 8A–O; 9A–F)

*Parasitus consanguineus* Oudemans & Voigts, 1904 in Voigts & Oudemans, 1904: 651. Costa, 1961: 265. Micherdzinski, 1969: 466. Karg, 1971: 446.

*Parasitus (Coleogamasus) consanguineus*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 88, 91.

*Parasitus setosus* Oudemans & Voigts, 1904 in Voigts & Oudemans, 1904: 653. Costa, 1961: 265.

*Parasitus thoni* (Berlese) sensu Sellnick, 1931: 743. Costa, 1961: 265.

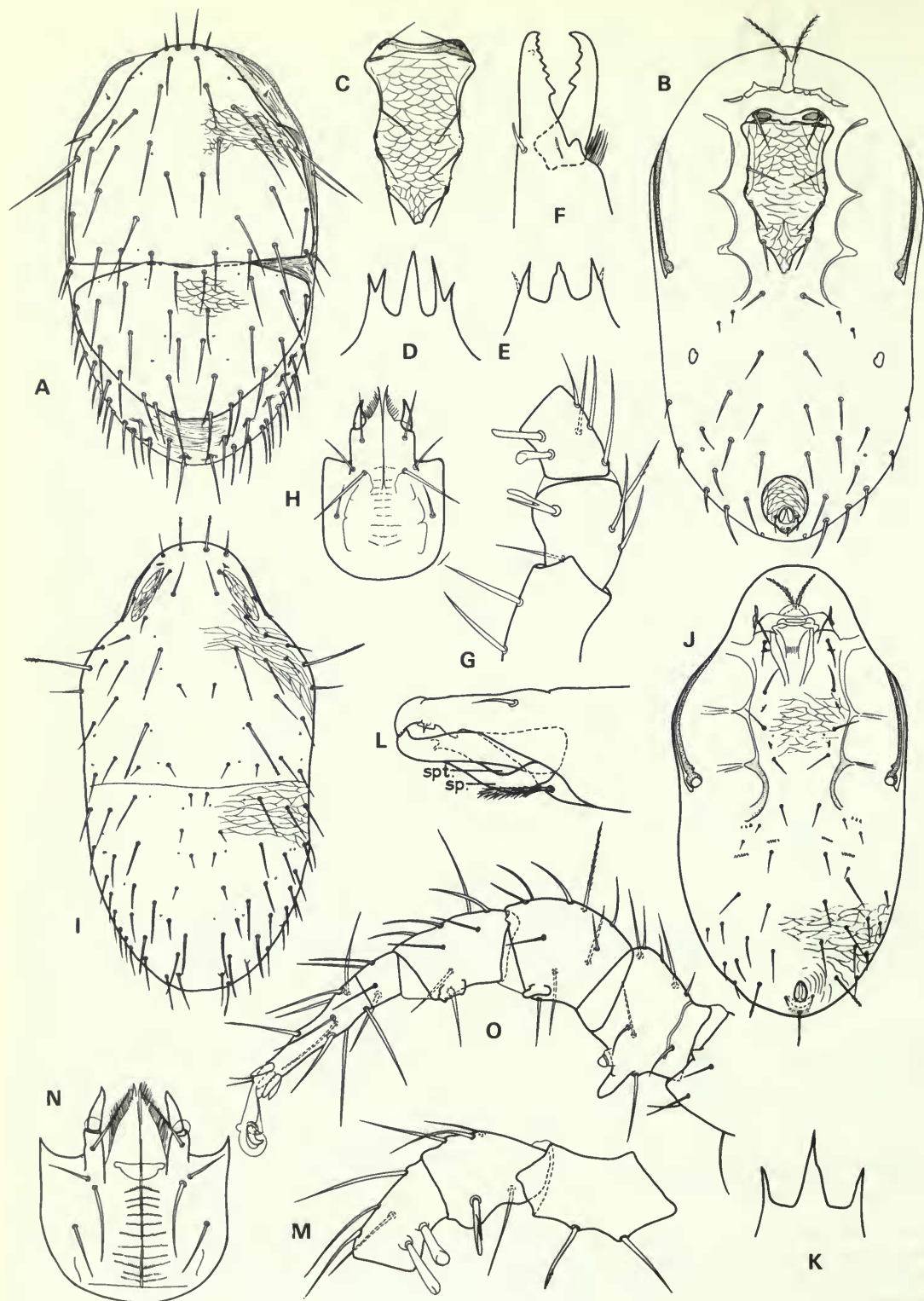
*Parasitus jugulatus* Schweizer, 1949: 10; 1961: 15. Costa, 1961: 265. Type examined.

*Eugamasus consanguineus*: Holzmann, 1969: 16.

The synonymy given above is that generally followed. A number of additional species have been described\* that share in the females the forked sternal seta I, and in the deutonymphs the characteristic '*jugulatus*' appearance of the sternal shield in which the sclerotization of

\**Gamasus (G.) mammillatus* Berlese, 1904, *Eugamasus numerus* Karg, 1965, *Eugamasus eustructurus* Holzmann, 1969 and *Parasitus tichomirovi* Davydova, 1969.





the anterior region gives the appearance, in many specimens, of having separate *jugular* shields (Fig. 8B). The deutonymphs also have the lateral prongs of the tectum bifid in varying degrees (Figs 8D & E). Recent comments by Karg (1972) and Costa (1975) have only served to emphasize the need for specialized collecting and laboratory rearing of complete life-cycles as has been done, for example, on *Parasitus copridis* Costa (Costa, 1964).

**DEUTONYMPH.** The dorsal shields are strongly sclerotized and in the majority of specimens are of a dull brown colour, conspicuous in both fresh spirit-preserved material and in permanent mounts. The podonotal shield (312–432  $\mu\text{m}$  long  $\times$  312–456  $\mu\text{m}$  wide) bears 20 pairs of simple setae, *s2* being situated off the shield (Fig. 8A). There are no stout setae. The opisthonotal shield (204–300  $\mu\text{m}$  long  $\times$  312–444  $\mu\text{m}$  wide) bears 13 pairs of simple setae. The setae on the posterior interscutal membrane are similar to those of the opisthonotal shield.

The tritosternum has a narrow base and pilose laciniae. It is flanked by conspicuously long fragmented presternal shields. The sternal shield (240–276  $\mu\text{m}$  long) is strongly sclerotized and completely reticulated and bears four pairs of simple setae. Anteriorly the sclerotization is frequently fragmentary with sternal setae I giving the appearance of being on separate shields or *jugularia* as in figure 8B. This condition appears to be extremely variable even within specimens from one sample, and an extreme example without signs of fragmentation, although with a weakly sclerotized anterior strip, is shown in figure 8C. The circular to oval anal shield is entirely reticulated and the anal setae are short and simple. The finely granular peritreme extends to the level of coxa I. The opisthogastric membrane bears approximately 16 pairs of simple setae which are not always symmetrically arranged. The metapodal shields are strongly sclerotized and may be almost square or circular.

The tectum is trispinate with the lateral prongs normally bifurcate (Fig. 8D), but some irregularity does occur (Fig. 8E). The chelicera is shown in figure 8F. Little variation has been noticed in the dentition. The chaetotaxy of the palp trochanter, femur and genu is as in figure 8G and the corniculi and gnathosomal setae in figure 8H. Ten rows of hypognathal denticles are normally clearly visible. All setae on the legs are simple although degrees of stoutness occur.

**MALE.** The dorsal shield (840–953  $\mu\text{m}$  long  $\times$  456–477  $\mu\text{m}$  wide) is entire with a transverse median suture (Fig. 8I). It is entirely reticulate and well sclerotized. The podonotal region bears 22 pairs of setae of which *j1*, *j4*, *z5* and *r3* are conspicuously stouter and generally finely pilose distally – at least on one margin. The opisthonotal region bears usually 26 or 27 pairs of setae of which few only show occasional pilosity. Setae *J1–J4* are short and noticeably finer than the remainder.

The tritosternum bears finely pilose laciniae but the base is very short and broad (Fig. 8J). The genital lamina protrudes anteriorly from the holoventral shield whilst the presternal shields are generally obscure or lacking. The sternogenital setae are fine and simple. There are approximately 15 pairs of opisthogastric setae, occasionally these are not paired, and one or two pairs in the anal region are finely pilose distally. The paranal setae are short and simple whilst the postanal is long and finely pilose distally. The peritreme extends to the anterior level of coxa I.

The tectum is trispinate but has the centre prong sometimes irregular (Fig. 8K). The chelicera is shown in figure 8L: the tips of the chelae are strongly rounded whilst the spermatodactyl curves strongly away from the movable digit basally. The palp trochanter, femur and genu are shown in figure 8M. The corniculi are strongly stalked and are curved at their tips, whilst the gnathosomal setae are simple (Fig. 8N). Eleven or more rows of hypognathal denticles are discernible. The leg setae are mainly simple, although some

Fig. 8 *Parasitus consanguineus* Oudemans & Voigts, deutonymph – A dorsum; B venter; C variant form of sternal shield; D, E tectum; F chelicera; G palp trochanter, femur and genu; H venter of gnathosoma; male – I dorsum; J venter; K tectum; L chelicera; M palp trochanter, femur and genu; N venter of gnathosoma; O leg II.

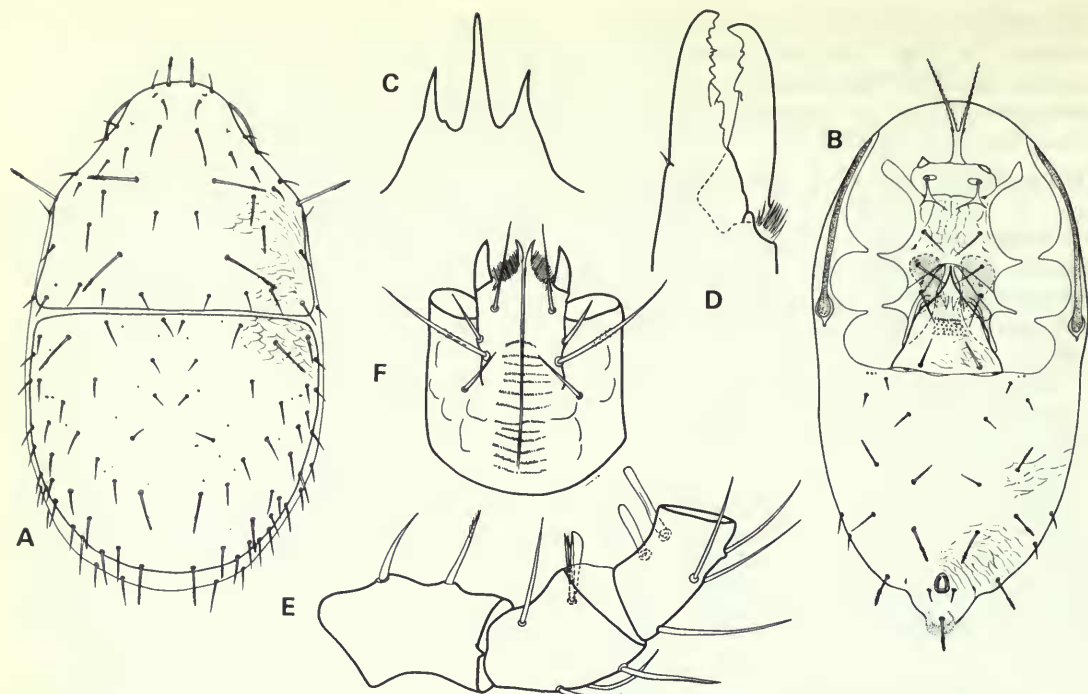


Fig. 9 *Parasitus consanguineus* Oudemans & Voigts, female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

dorsals are erect and usually finely pilose at least on one margin. Leg II is shown in figure 8O. The femoral spur is smooth in outline and the auxiliary is short and domed.

**FEMALE.** The podonotal shield (518–552  $\mu\text{m}$  long  $\times$  528–624  $\mu\text{m}$  wide) bears 21 pairs of setae of which *j1*, *j4*, *z5* and *r3* are conspicuously longer and stouter than the remainder and are more clearly very finely pilose distally (Fig. 9A). The opisthonotal shield (591–600  $\mu\text{m}$  long  $\times$  546–636  $\mu\text{m}$  wide) bears at least 31 or 32 pairs of setae of which the stoutest are finely pilose distally, and *J1–J4* are, as in the male, short and finer than the remainder. The posterior interscutal membrane bears few setae.

The tritosternum has pilose laciniae and a narrow base. It is flanked by rudimentary presternal shields (Fig. 9B). The sternal shield is rather weakly sclerotized anteriorly and sternal setae I, which are forked distally, arise from small plates situated in the weakly sclerotized area. Sternal setae II–IV are simple and of equal length, but *st. IV* (the metasternals) are slightly more slender. The genital shield is tall and triangular with a pointed apex whilst the setae are simple. Internally, the most conspicuous part of the endogynium is the rows of teeth across the centre of the genital shield. The opisthogastric shield is well sclerotized and bears 10 pairs of setae of which four pairs are stout with some pilosity distally. The paranal setae are short (c. 37  $\mu\text{m}$ ) and simple whilst the postanal is long (c. 80–95  $\mu\text{m}$ ) and pilose distally. The peritreme extends anteriorly to beyond coxa I.

The tectum (Fig. 9C) is strong and broadly trispinate with the centre prong longest. The chelicera (Fig. 9D) bears three teeth on the movable digit and four on the fixed. The palp trochanter, femur and genu (Fig. 9E) are as in the male. The corniculi are smooth and the gnathosomal setae are simple with the external posterior rostrals almost twice as long as the others. There are 13 rows of more or less distinct hypognathal denticles (Fig. 9F). The leg setae are almost all simple although some show traces of fine pilosity. Genu II and genu and tarsus IV each bear one stout dorsal seta which is clearly but finely pilose distally.

**MATERIAL EXAMINED.** 47 samples – 3 PNN, 74 DNN, 12 ♂♂, 22 ♀♀.

ENGLAND: Isles of Scilly, Dorset, Hampshire, Sussex, Surrey, Kent, London, Middlesex,



Berkshire, Buckinghamshire, Essex, Norfolk, Derbyshire, Nottinghamshire, Manchester, Lancashire, Yorkshire.

WALES: Anglesey.

SCOTLAND: Glasgow, Iona, Mull, Orkney.

IRELAND: Cork.

Most samples were obtained from decaying vegetable matter, compost, or from manure with straw and a few were from surface leaf-litter. One sample was obtained from spent hops, another from grain spillage and two from seashore debris. Also one, Manchester, 28 August 1936 on *Aphodius rufipes* (L.) (Coleoptera), one, no data, J. E. Hull Collection, from *Geotrupes* sp. (Col.), and one from Norfolk, 1969, on *Bombus pascuorum* (Scopoli) (Hymenoptera), coll. Miss S. P. Greenwood. A single deutonymph from a starling's nest in a sand martin's burrow, Ballycroneen Strand, Co. Cork, 3 June 1964, coll. A. J. M. Claassens, is the only record from Ireland.

**DISTRIBUTION.** Only previously recorded in the British Isles by Hull (1918) from Northumberland and Miles (1955) from Cardiganshire, this species is never found abundantly.

It is recorded from Iceland (Sellnick, 1940), Sweden (Sellnick, 1958), Holland (Oudemans Collection), Belgium (van Daele & Heungens, 1974, 1975), Germany (Voigts & Oudemans, 1904, Karg, 1965, 1971, Holzmann, 1969, Micherdzinski, 1969), U.S.S.R. (Pinchuk, 1976), Ukraine (Pirjanik, 1962), Western Siberia (Davydova, 1969, 1976), Greece (Sellnick, 1931) and Israel (Costa, 1961, 1966). Its habitats are mainly dung and compost with additionally arable and meadow land.

***Parasitus copridis* Costa**  
(Fig. 10A–P)

*Parasitus copridis* Costa, 1963: 29; 1964: 209. Micherdzinski, 1969: 417. Davydova, 1976: 89.

*Parasitus (Coleogamasus) copridis*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 83, 89.

**DEUTONYMPH.** The podonotal shield (444–502  $\mu\text{m}$  long  $\times$  504–564  $\mu\text{m}$  wide) is finely reticulated and bears 20 pairs of setae, *s*<sub>2</sub> being situated off the shield. The relative lengths of the setae are shown in figure 10A. The opisthonotal shield (300–336  $\mu\text{m}$  long  $\times$  456–540  $\mu\text{m}$  wide) is also finely reticulated. It bears 14 pairs of setae of which only *Z*<sub>3</sub>, situated on the margin, are long (c. 260  $\mu\text{m}$ ) (Costa, 1963 gives 390  $\mu\text{m}$ ), stout and finely pilose. The remaining setae are fine and short (c. 47  $\mu\text{m}$  maximum). The interscutal membrane bears short, simple setae only.

The tritosternum has a narrow base and pilose laciniae. The presternal shields are weakly sclerotized. The sternal shield (336–360  $\mu\text{m}$  long) is finely reticulated (Fig. 10B). The setae are simple but *st*. I are the longest. The broadly oval anal shield is also reticulated. The paranal setae are short and simple, the postanal is minute and thornlike. The median opisthogastric setae are the longest, the laterals short like those on the dorsal membrane. The peritreme extends to the anterior margin of coxa I.

The tectum has a tapered broad central projection and is flanked by a pair of incurved horns (Fig. 10C). The chelicera is shown in figure 10D. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 10E. The venter of the gnathosoma is shown in figure 10F: the corniculi are directed inwards slightly and the gnathosomal setae are strong, whilst the hypognathal denticles are well defined. The setae on leg I are mainly slender and simple but legs II–IV bear stouter setae. An erect barbed dorsal seta is present on genu III and similar but longer single setae are present on femur and tarsus IV.

**MALE AND FEMALE.** The adults have not been collected in the British Isles. Costa (1964) has reared this species in the laboratory and has figured all active developmental stages. Figures 10G–10K of the male and figures 10L–10P of the female are based on Costa's paper. The idiosoma of the male measures 1130–1295  $\mu\text{m}$  long  $\times$  630–710  $\mu\text{m}$  wide, and the female 1190–1480  $\mu\text{m}$  long  $\times$  750–810  $\mu\text{m}$  wide.

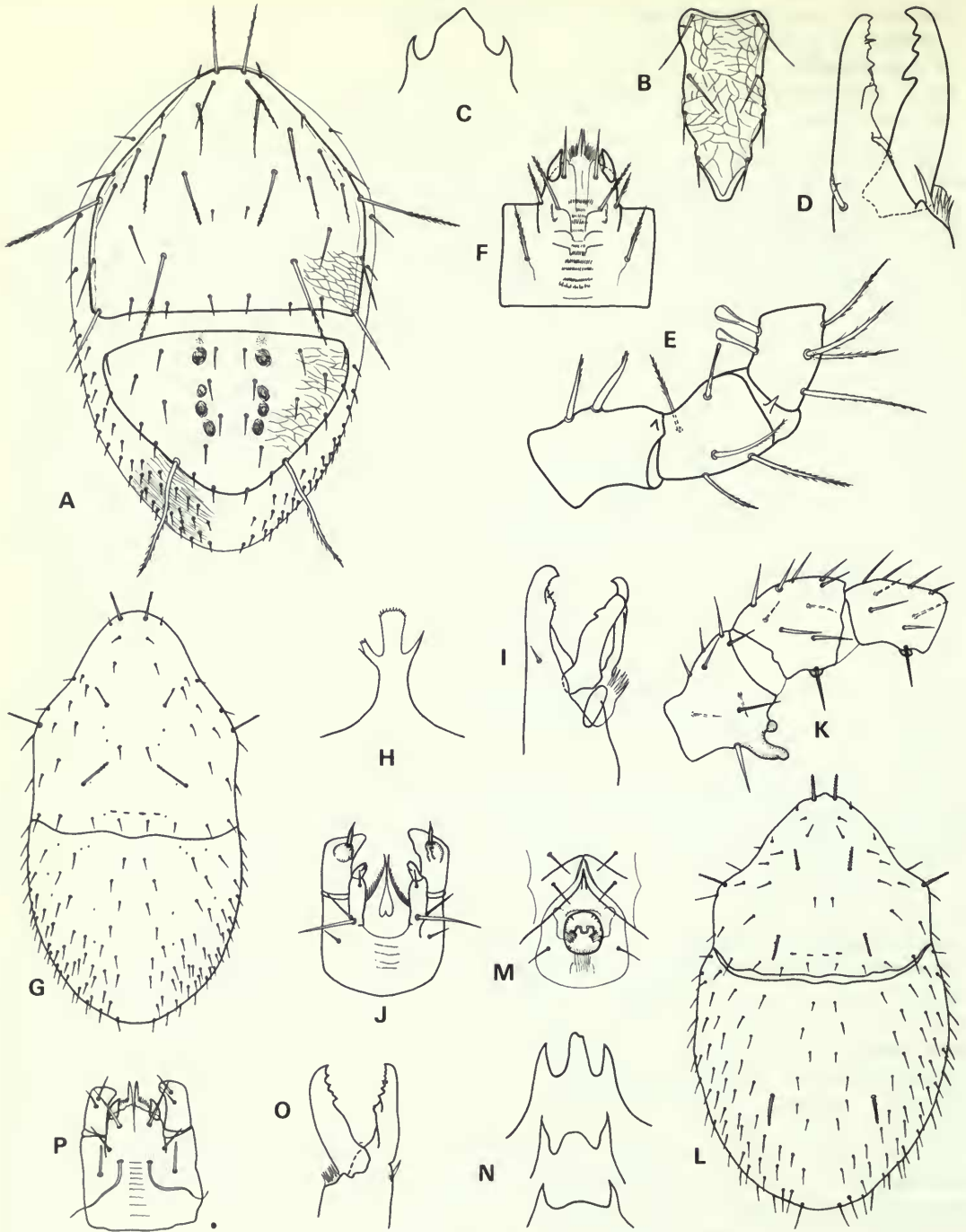


Fig. 10 *Parasitus copridis* Costa, deutonymph—A dorsum; B sternal shield; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma: male—G dorsum; H tectum; I chelicera; J venter of gnathosoma and palp trochanters; K femur, genu and tibia of leg II: female—L dorsum, M genital region; N tectum showing variation; O chelicera; P venter of gnathosoma and palp trochanters. G–P after Costa, 1964.

MATERIAL EXAMINED. 12 samples – 111 DNN.

ENGLAND: Isles of Scilly, Surrey, Middlesex, Yorkshire, Northumberland.

SCOTLAND: Outer Hebrides (Shillay).

All were associated with beetles, eight samples were from *Geotrupes spiniger* (Marsham) and four were from *G. stercorarius* (L.).

DISTRIBUTION. Previously known only from *Copris hispanus* (L.) (Coleoptera) in Israel (Costa, 1963, 1964, 1966) and from unspecified beetles in Western Siberia (Davydova, 1976), this species is now recorded from the British Isles for the first time.

*Parasitus evertsi* Oudemans

(Fig. 11A–L)

*Parasitus evertsi* Oudemans, 1902d: 283, non synonym *Gamasus furcatus* G. & R. Canestrini, 1882: 49. Berlese, 1906: 172. Micherdzinski, 1969: 539. Type examined.

Oudemans (1902d) described *Parasitus evertsi* from a single female found in decaying leaves in the south of France. His slide is labelled 'Cauterets, Hautes Pyrenées, France, Aug. 1900, Jhr. Dr Ed. J. G. Everts'. I have compared the females examined during the present study with Oudemans's specimen and consider them to be conspecific. Berlese (1906) also examined Oudemans's type and synonymized *evertsi* with *Gamasus furcatus* G. & R. Canestrini, 1882, as he found few differences between the two species. Micherdzinski (1969) and Tichomirov (1969) cited this synonymy. Between 1906 and 1969 however, this does not appear to have been referred to. There have been several records of *furcatus* in recent years, viz. Schweizer (1961), Holzmann (1969), Micherdzinski (1969), Karg (1971) and Bregetova *et al.* (1977), and all refer to the true *furcatus* of G. & R. Canestrini in which the male chelicerae have the fixed digit enlarged distally. Additionally the male tectum is apparently characteristically bifid in *furcatus* and also the accessory spur on femur II is rounded and not angular as in *evertsi*. There is no doubt in my mind that the males and females of *evertsi* figured here are conspecific (five of the fifteen samples contained both sexes) and consequently this is the first description of the male of *evertsi*.

DEUTONYMPH. Unknown.

MALE. The idiosoma measures 890–936  $\mu\text{m}$  long  $\times$  490–528  $\mu\text{m}$  wide. It is entirely reticulated and heavily sclerotized and is divided by a transverse slit which generally results in the posterior and anterior portions of the dorsum overlapping. Many of the setae arise from raised bases. A pair of pores is located laterally a little anterior to the slit, and these are most conspicuous in specimens that are compressed (Fig. 11A). The podonotal region bears 21 pairs of setae of which *j1*, *j4*, *z5* and *r3* are long and stout and with fine pilosity. The remainder are short and with only traces of pilosity. The opisthonotal region bears about 21 pairs of setae which become stouter and more pilose posteriorly. In the specimen figured one seta of a pair (?S5) is deformed and bifid.

The tritosternum has a short narrow base, partly covered by the genital lamina, and pilose laciniae. The holoventral shield is strongly sclerotized and entirely reticulated (Fig. 11B). *St. I* are the longest of the sternal setae, *st. II–IV* becoming progressively shorter. The remaining ventral setae tend to become longer and stouter towards the posterior and show some degree of pilosity. The postanal seta is longer than the paranals. The peritreme extends to coxa I.

The tectum comprises a rounded central tine flanked by a pair of narrow tines that are either pointed or split distally (Fig. 11C). The chelicera is shown in figure 11D. The stout dorsal seta is inset. The chaetotaxy of the palp trochanter, femur and genu is similar to the female (Fig. 11L). The venter of the gnathosoma is as in figure 11E. The setae are fine and simple, the external posterior hypostomatic being the shortest. Leg I bears mainly simple slender setae. Leg II is shown in detail in figure 11F. Legs III and IV bear stouter setae generally than leg I and some are pilose, whilst ventrally several are thornlike.



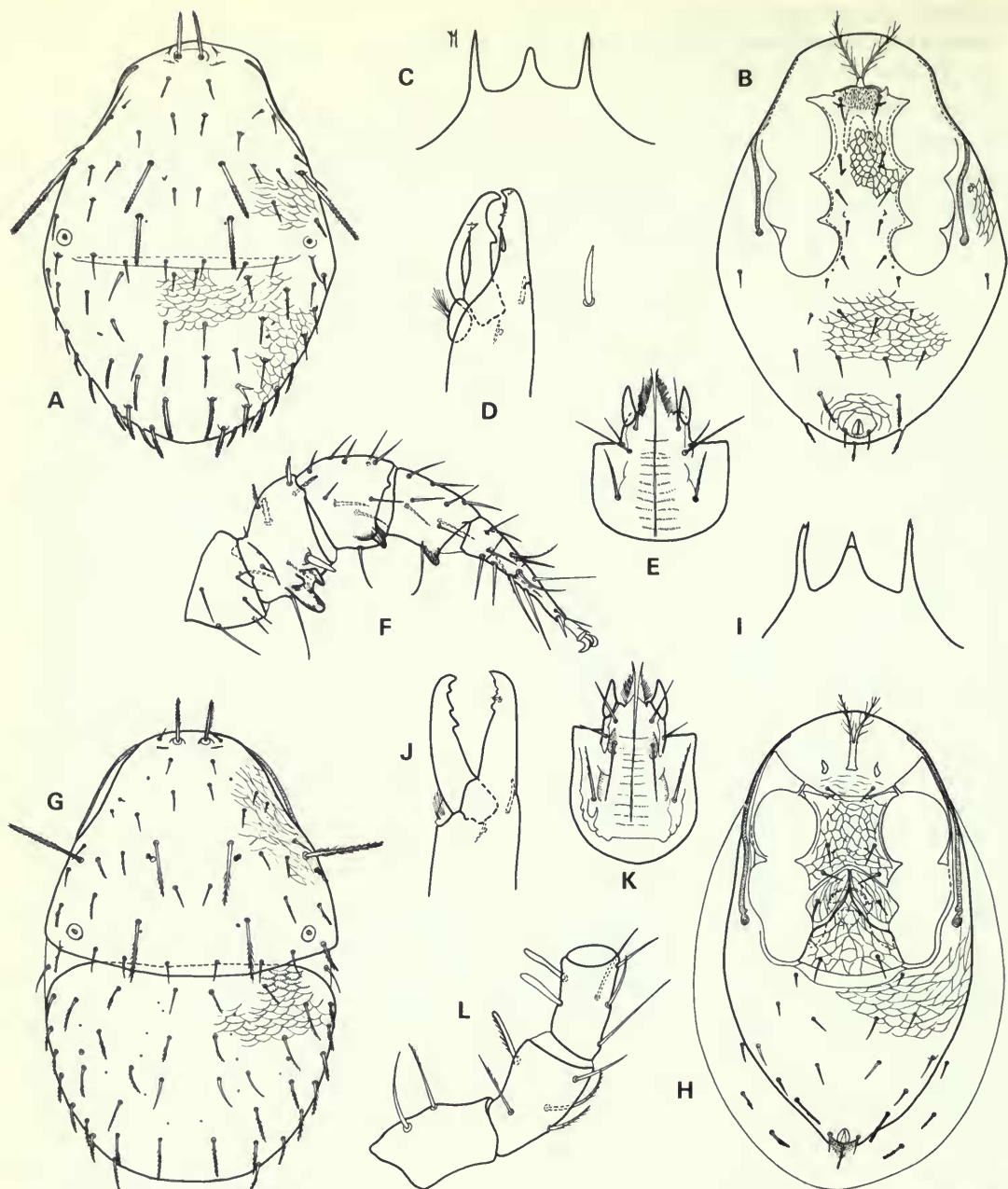


Fig. 11 *Parasitus evertsi* Oudemans, **male**—A dorsum; B venter; C tectum; D chelicera; E venter of gnathosoma; F leg II: **female**—G dorsum; H venter; I tectum; J chelicera; K venter of gnathosoma; L palp trochanter, femur and genu.

**FEMALE.** The podonotal shield (504–564  $\mu\text{m}$  long  $\times$  600–636  $\mu\text{m}$  wide) is well sclerotized and entirely reticulated and bears 21 pairs of setae and, like the male, it has a pair of conspicuous pores posterolaterally (Fig. 11G). As in the male also, setae *j1*, *j4*, *z5* and *r3* are long and stout with fine pilosity. The opisthonotal shield (432–480  $\mu\text{m}$  long  $\times$  588–612  $\mu\text{m}$  wide) is well sclerotized and entirely reticulated. It bears 17–20 pairs of setae which, like the male, become stouter and more pilose posteriorly.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of small crescentic presternal shields. The ventral shields are well sclerotized and entirely reticulated (Fig. 11H). Sternal setae I are situated on unsclerotized membrane anterior to the first pair of pores. All the sternogenital setae are simple. The genital shield is strongly pointed anteriorly. The opisthogastric shield bears seven pairs of setae of which the pair nearest the anus is pilose. The postanal seta is pilose at its tip and is longer than the simple paranals. The peritreme extends to coxa I.

The tectum (Fig. 11I) sometimes has the centre prong broken off and the lateral prongs are usually divided at their tips. The chelicera is shown in figure 11J, and the venter of the gnathosoma in figure 11K. The palpcoxal setae show slight pilosity. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 11L. The setae of leg I are mainly fine and slender. Legs II and III bear some stout ventral setae and leg IV has a strong pilose dorsal seta (c. 125  $\mu$ m) on the tarsus.

**MATERIAL EXAMINED.** 16 samples – 11♂♂, 18♀♀

**ENGLAND:** Cornwall, Devon, Dorset, Isle of Wight, Berkshire, Birmingham, Lancashire.

**WALES:** Monmouthshire, Caernarvonshire.

**IRELAND:** Leitrim.

Specimens were found in the following habitats: a cave, tree-holes, on *Sorex araneus* L., sewage filter beds, on bracket fungus, greenhouse soil, hedgerow debris, freshwater flood debris and seaweed.

**DISTRIBUTION.** This species has only been authentically recorded from the south of France (Oudemans, 1902*d*) (see discussion above).

***Parasitus fimetorum* (Berlese)**  
(Figs 12A–O; 13A–M; 14A–G)

*Gamasus fimetorum* Berlese, 1904*a*: 238; 1906: 135.

*Eugamasus fimetorum*: Holzmänn, 1969: 14.

*Parasitus fimetorum*: Micherdzinski, 1969: 478 (in part, see Karg, 1972: 57). Karg, 1971: 448.

*Parasitus (Coleogamasus) fimetorum*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 86, 89.

*Parasitus affinis* Oudemans, 1904*b*: 120. Berlese, 1906: 135.

*Parasitus eta* Oudemans & Voigts, 1904 in Voigts & Oudemans, 1904: 652. **Syn. nov.** Type examined.

*Parasitus hibernicus* Turk & Turk, 1952: 475. **Syn. nov.** Types examined.

This is the only species for which, during the course of the present study, larvae and protonymphs were both available, and the opportunity is taken to figure and describe briefly these two stages.

**LARVA.** The dorsum (c. 290  $\mu$ m long  $\times$  c. 180  $\mu$ m wide) bears 18 pairs of simple setae distributed as in figure 12A: nine pairs are situated on the very weakly sclerotized and poorly defined podonotal shield and nine pairs on the unsclerotized opisthonotal cuticle. Setae *z5* are the stoutest and longest and are finely pilose.

The tritosternum has a long narrow base and the laciniae, which are strongly forked, are separated at their proximal ends by a bifid protrusion of the base (Fig. 12B). The sternal region bears three pairs of simple setae and is without trace of a sternal shield, whilst the anal shield, which is just discernible, bears the normal three setae associated with the anus and additionally a pair of euanal setae on the anal valves. However, as in *Pergamasus*, the paranal and postanal setae are exceptionally long in the larva, whilst the euanal setae will not be present in the protonymph. The remainder of the opisthogastric region bears four pairs of simple setae. Peritremes and stigmata are absent.

The tectum is trispinate with the broad centre prong weak and varying in length, the lateral prongs strong and slender (Fig. 12C, D). The chelicera is shown in figure 12E. The movable digit, which measures c. 33.6  $\mu$ m, bears three conspicuous teeth, the teeth of the fixed digit are less well formed. The gnathosoma, which lacks hypognathal denticles and

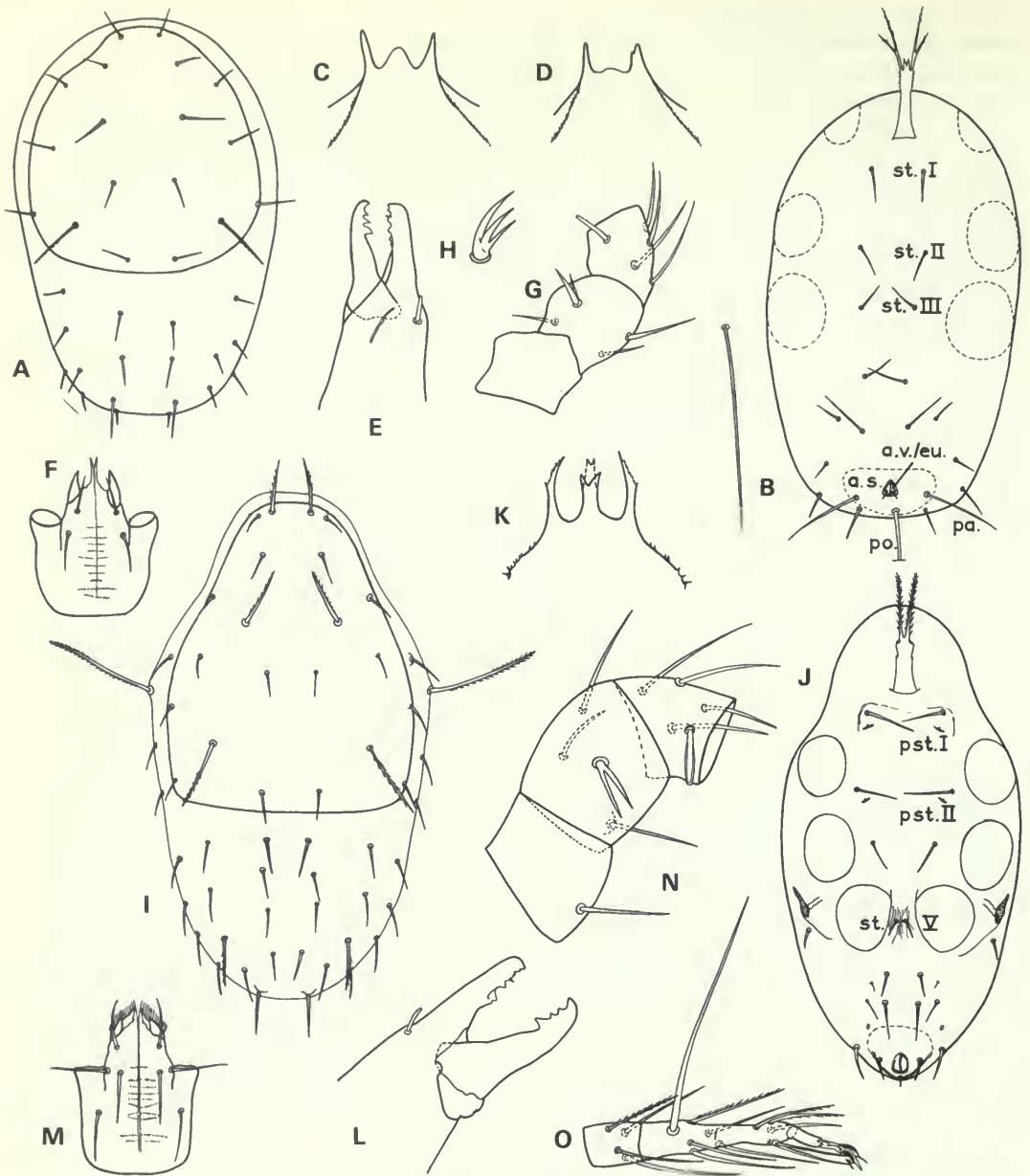


Fig. 12 *Parasitus fimetorum* (Berlese), larva – A dorsum; B venter; C, D tectum; E chelicera; F venter of gnathosoma; G palp trochanter, femur and genu; H apotele of palp tarsus; protonymph – I dorsum; J venter; K tectum; L chelicera; M venter of gnathosoma; N palp trochanter, femur and genu; O tarsus of leg IV. Abbreviations in text, p. 245.

bears only two pairs of ventral setae, the anterior hypostomatic and the external posterior hypostomatic, is shown in figure 12F. The palp trochanter is devoid of setae, whilst the femur and genu bear four and five setae respectively (Fig. 12G), and the strong tarsal apotele is three tined (Fig. 12H).

**PROTONYMPH.** In the protonymphal stage the podonotal shield is more clearly defined than in the larva and the opisthonotal region is generally stronger. The podonotal shield measures



288–324  $\mu\text{m}$  long  $\times$  252–300  $\mu\text{m}$  wide, whilst the opisthonotal region, still without clear sclerotization, measures 156–204  $\mu\text{m}$  long  $\times$  216–264  $\mu\text{m}$  wide (Fig. 12I). The podonotal region bears 15 pairs of setae of which 11 are situated on the shield, and the opisthonotal region bears 13 pairs.

The larval tritosternum is replaced at this stage by a form more typical of the deutonymphs and adults (Fig. 12J). The unsclerotized sternal region bears three pairs of simple setae and two pairs of pores, a fourth pair which are noticeably short, are situated on the membrane between coxae IV. The opisthogastric region bears six pairs of setae whose relative lengths are shown in the figure. The anal shield is smaller at this stage than in the larva and bears only the normal paranal and postanal setae – the larval euanals having disappeared. The stigma is situated opposite coxa IV and the peritreme extends anteriorly for approximately 38  $\mu\text{m}$ .

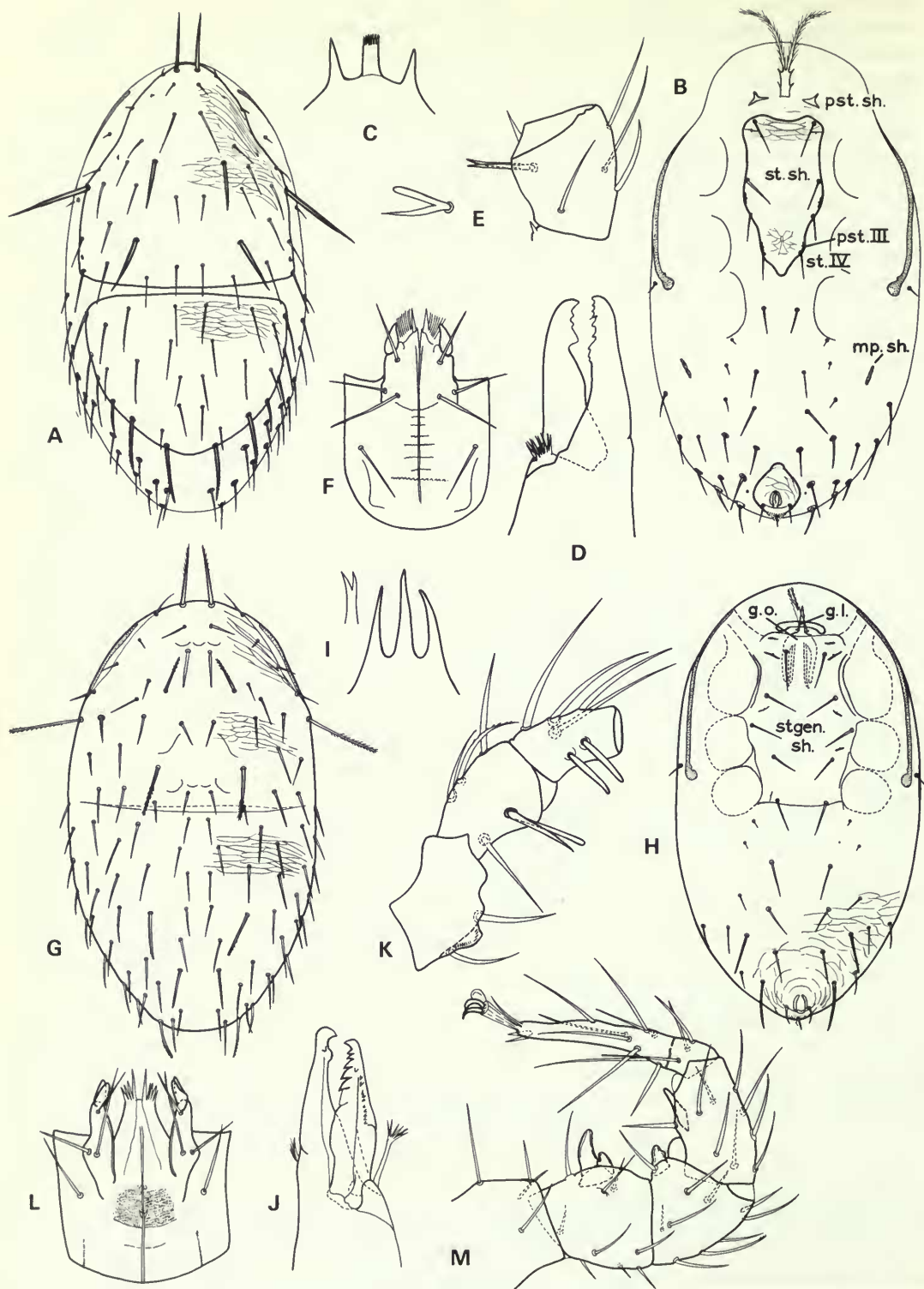
The tectum is trispinate and well developed (Fig. 12K), the only variation observed being in the bifurcation and breadth of the centre spine. The chelicera (Fig. 12L) is almost identical with that of the larva, whilst the venter of the gnathosoma (Fig. 12M) has the full complement of setae and at least ten rows of hypognathal denticles. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 12N. The leg setae are still basically simple although they are of less uniform length in that the proximal segments now bear a number of relatively shorter setae. Additionally, however, tarsus IV bears dorsally a long erect simple seta (c. 260  $\mu\text{m}$ ) (Fig. 12O) and the fine pilosity has disappeared from several others.

**DEUTONYMPH.** The dorsal shields are strongly sclerotized, entirely reticulated and of noticeably constant outline (Fig. 13A). The podonotal shield (379–456  $\mu\text{m}$  long  $\times$  354–500  $\mu\text{m}$  wide) bears 20 pairs of setae, *s2* being situated off the shield. Setae *j1*, *j4*, *z5* and *r3* are considerably stouter and longer than the remainder which are, in this species, extremely fine and slender. The longest setae, *r3* (c. 170  $\mu\text{m}$ ), are also finely pilose. The opisthonotal shield (253–320  $\mu\text{m}$  long  $\times$  328–470  $\mu\text{m}$  wide) bears 15 pairs of setae of which two, *J5* and *Z3*, are stout and longer (90–95  $\mu\text{m}$ ) than the remainder (50–70  $\mu\text{m}$ ), and a third, *S4*, is also stout and measures c. 60  $\mu\text{m}$  in length. The inner setae are very fine and slender. The setae on the posterior membrane are slightly stouter than the fine dorsal setae, and most arise from small platelets.

The tritosternum has a narrow base and strong pilose laciniae. It is flanked by clear but weakly sclerotized triangular presternal shields (Fig. 13B). The sternal shield (264–290  $\mu\text{m}$ ) bears four pairs of fine simple setae. Between *st. 1* and close to the concave anterior edge of the shield lies a transverse area which appears, especially in uncleared specimens, to be unsclerotized. The egg-shaped anal shield bears the normal three setae associated with the anus, and the metapodal shields are slender and granular. The finely granular peritreme extends to the level of coxa I. The membrane posterior to the sternal shield bears approximately 16 pairs of simple setae, those nearest the anal shield arising from sclerotized platelets.

The tectum is trispinate with the centre prong almost invariably broken off (Fig. 13C) or even deformed. The chelicera is as in figure 13D. The palp femur is shown in figure 13E and the strongly forked anterolateral seta is also shown from a different angle. The two anterolateral setae on the palp genu are spatulate. The corniculi and gnathosomal setae are as in figure 13F. Only eight rows of hypognathal teeth are generally discernible. All setae on the legs are simple and of rather constant thickness. Tarsus IV bears dorsally a conspicuous erect seta c. 120  $\mu\text{m}$  in length.

**MALE.** The dorsum (880–960  $\mu\text{m}$  long  $\times$  518–552  $\mu\text{m}$  wide) is entire with a transverse suture (Fig. 13G). It is entirely reticulated but not usually heavily sclerotized. The dorsal chaetotaxy does not exhibit such extremes of setal length as for example *P. consanguineus* (Fig. 8I) although setae *j5*, *j6* and *J1–J4* are noticeably finer than the surrounding setae. The podonotal region bears 21 pairs of setae (although in the specimen figured *s3* on the left side is missing) of which *j1*, *j4*, *z5* and *r3* are conspicuously longer and stouter than the remainder.



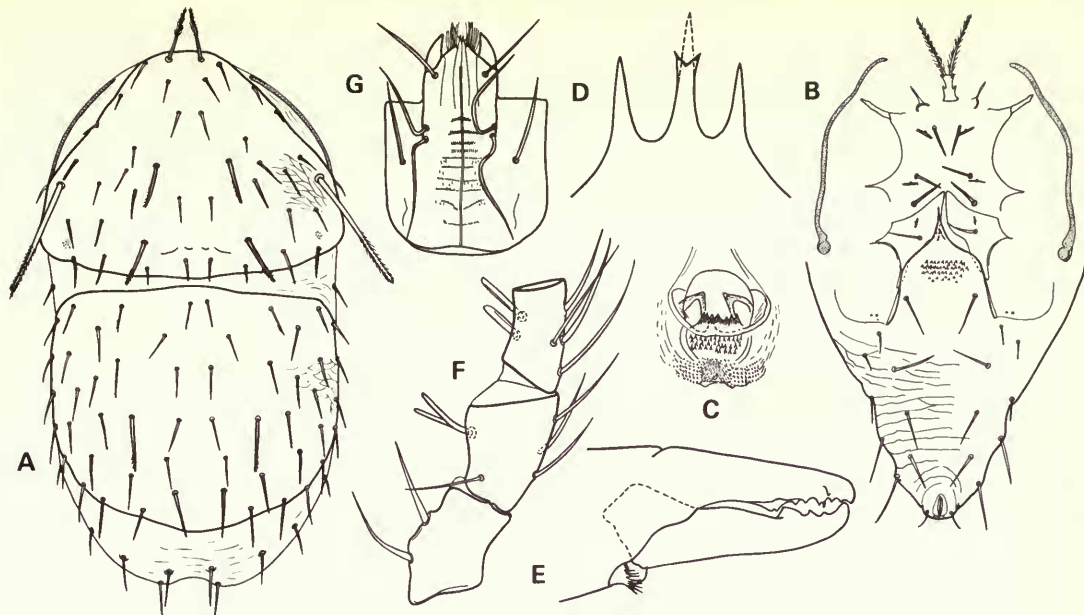


Fig. 14 *Parasitus fimetorum* (Berlese), female – A dorsum; B ventral sclerotization; C endogynium; D tectum; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma.

The opisthonotal region bears approximately 31 pairs of setae of which Z3 are apparently the stoutest, although Z2 and several in the S-series are almost as stout.

The tritosternum is small although appears in most specimens examined to show two short pilose laciniae and a rudimentary base. It is often completely covered by the protruding genital lamina (Fig. 13H). The sternogenital setae are simple. The paired paranal and single postanal setae are typically short, and the opisthogastric region bears approximately 11 pairs of setae of which the most posterior pair is the longest (*c.* 108  $\mu\text{m}$ ). The peritreme extends anteriorly to coxa I.

The tectum is trispinate with the outside prongs curved inwards, whilst the centre prong is either plain or forked at its tip (Fig. 13I). The chelicera is shown in figure 13J. The movable digit bears three large and two small teeth on the inner edge and a row of small pointed teeth lower on the inner face, the spermatodactyl lies close to the digit. The fixed digit bears only a cusp of small denticles distally. The palp trochanter, femur and genu are shown in figure 13K: the trochanter bears a shallow keel-like ridge ventrally. The corniculi are strongly stalked and deeply cleft (Fig. 13L), and the gnathosomal setae are simple whilst the normal row of hypognathal denticles is replaced by an area of rasp-like projections. The leg setae are similar to those of *P. consanguineus*, the slightly stouter ones being generally finely pilose on at least one margin. Leg II is shown in detail in figure 13M. No significant variation has been observed in the form of the spurs.

**FEMALE.** The podonotal shield (456–540  $\mu\text{m}$  long  $\times$  432–528  $\mu\text{m}$  wide) bears 21 pairs of setae of which *j1*, *j4*, *z5* and *r3* are conspicuously longer and stouter than the remainder and are usually finely pilose (Fig. 14A). The opisthonotal shield (425–504  $\mu\text{m}$  long  $\times$  444–570  $\mu\text{m}$  wide) bears 26 pairs of setae of which Z3 are usually the stoutest and are finely pilose. The posterior interscutal membrane bears only about five pairs of setae dorsally. Both shields are

Fig. 13 *Parasitus fimetorum* (Berlese), deutonymph – A dorsum; B venter; C tectum; D chelicera; E palp femur and anterolateral seta; F venter of gnathosoma: male – G dorsum; H venter; I tectum; J chelicera; K palp trochanter, femur and genu; L venter of gnathosoma; M leg II. Abbreviations in text, p. 245.



very weakly sclerotized and in fact few specimens have been examined in which the shields can be delineated clearly. Additionally, although the figure illustrates a typical example, variations in setal thickness and length are common without being extreme enough to warrant additional illustration. The idiosoma is characteristically concave postero-medially giving a 'waisted' appearance.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of weakly sclerotized presternal shields of a constant and conspicuous form (Fig. 14B). The sternal shield is very weakly sclerotized and bears three pairs of strong simple setae. The metasternal and genital setae are less stout. The genital shield is strongly pointed anteriorly, but posteriorly it merges into the weakly sclerotized and narrow opisthogastric shield. The most conspicuous elements of the endogynium are shown in figure 14C, but there is often considerable distortion and displacement of the individual structures. The three anal setae are short as are three of the eight pairs of opisthogastric setae. The peritreme extends anteriorly to coxa I.

The tectum is trispinate with the median prong either long and pointed or shorter and regularly bifid (Fig. 14D). The chelicera is shown in figure 14E, the chaetotaxy of the palp trochanter, femur and genu is as in the male, but the trochanter lacks the ventral keel-like ridge (Fig. 14F). The corniculi are broad and smooth. The gnathosomal setae are simple with the posterior hypostomatics long and contorted (Fig. 14G). There are usually ten pairs of conspicuous hypognathal denticles. The leg setae are simple although many are sinuous to some degree.

**MATERIAL EXAMINED.** 128 samples – LL, PNN, 399 DNN, 65 ♂♂, 105 ♀♀, plus some half a dozen samples containing almost countless specimens of all stages from larva to adult.

**ENGLAND:** Cornwall, Isles of Scilly, Devon, Dorset, Somerset, Gloucestershire, Bristol, Berkshire, Isle of Wight, Hampshire, Sussex, Middlesex, London, Kent, Surrey, Essex, Hertfordshire, Buckinghamshire, Norfolk, Suffolk, Cambridgeshire, Northamptonshire, Birmingham, Staffordshire, Lancashire, Cheshire, Cumberland, Yorkshire, Northumberland.

**WALES:** Anglesey, and North Wales (no precise locality, see below).

**SCOTLAND:** Berwickshire, Dunbartonshire, Aberdeenshire, Inner Hebrides (Muck, Iona, Ulva).

**IRELAND:** Cork, Wexford, Kildare, Meath, Westmeath.

**CHANNEL ISLANDS:** Jersey.

This is one of the most widespread European species of *Parasitus* and is distributed throughout the British Isles. The bulk of the material examined is from stacked rotting vegetation, compost, manure and dung. Some is from small mammal nests (*Sorex*, *Neomys*, *Talpa*, *Microtus*, *Apodemus*, *Micromys*), some associated with beetles (*Aphodius*, *Geotrupes*, *Nicrophorus*, *Atholus*) and bumblebees (*Bombus*) and also occasionally from birds' nests (*Rissa*, *Vanellus*, *Delichon*, *Riparia*), and some from poultry litter (Brady, 1970), bat dung, and from a dead fox *Vulpes vulpes* (L.) (Smith, 1975). Few records only are from leaf litter, mosses or grassland. The only specimens examined from the seashore are two deutonymphs from seaweed, Benllech, Anglesey, October 1961, coll. P. N. Lawrence. Halbert (1920) does not mention this species in 'The Acarina of the Seashore' and I have not found it in similar samples collected by myself on the Isles of Scilly or in north Kent.

**DISTRIBUTION.** Previous British records are from the Tyne Province and also Lancashire, Yorkshire and Cheshire (Hull, 1918), Ireland (Halbert, 1915), Hertfordshire (Hyatt, 1956), the Channel Islands (Browning, 1956), Huntingdonshire (Davis, 1970) and London (Smith, 1975). Hill & Gordon (1945) recorded '*Parasitus* sp. 10 nymphs' from the straw used to stuff the palliasses of American servicemen stationed in North Wales (the localities could not be given at the time). I have examined one of these specimens and it is a deutonymph of *fimetorum*.

It is recorded from Iceland (Sellnick, 1940), Holland (Oudemans Collection), Belgium (van

Daele & Heungens, 1974, 1975), Germany (several authors, see Micherdzinski, 1969), Austria (Irk, 1941, Leitner, 1946), Switzerland (Schweizer, 1949, 1961), Italy (Berlese, 1906), Poland (Micherdzinski, 1969). U.S.S.R. (Pinchuk, 1976), Western Siberia (Davydova, 1969, 1976), and Canada (Richards, 1976, Richards & Richards, 1976). Like the British material examined, most records are from composts and dung. The inclusion of Israel (Bodenheimer, 1949) by Micherdzinski (1969 : 484) is in error. Bodenheimer specifically stated (p. 33) that his ectoparasites had not been identified beyond orders. The record of Costa (1961) from Israel is referable to *Parasitus bituberosus* Karg, 1972, as are presumably Costa, 1962, 1963 and 1966.

*Parasitus hyalinus* (Willmann)  
(Fig. 15A–L)

*Eugamasus hyalinus* Willmann, 1949a: 110. Holzmann, 1969: 15.

*Parasitus hyalinus*: Micherdzinski, 1969: 529. Karg, 1971: 447.

*Parasitus (Vulgarogamasus) hyalinus*: Bregetova *et al.*, 1977: 80.

**DEUTONYMPH.** This description is taken from three very weakly sclerotized specimens, two of which are moulting to females. The podonotal shield averages  $250\ \mu\text{m}$  long  $\times$   $265\ \mu\text{m}$  wide. It is lightly reticulated and bears 20 pairs of simple setae (Fig. 15A). Setae *s*<sub>2</sub> are off the shield, *r*<sub>3</sub> are the longest and *z*<sub>5</sub> are barely longer than adjacent setae. The opisthonotal shield averages  $180\ \mu\text{m}$  long  $\times$   $250\ \mu\text{m}$  wide, bears 14–15 pairs of simple setae, and is lightly reticulated. The setae on the posterior membrane are short.

The tritosternum has a narrow base and pilose laciniae. The sternal shield measures *c.*  $180\ \mu\text{m}$  long and is in outline more characteristic of some *Pergamasus* species (Fig. 15B). It is lightly reticulated and the setae are simple. The presternal shields are rudimentary. The opisthogastric setae are simple and the anal shield is oval in outline with the anal setae simple. The extremely narrow peritreme extends to coxa I.

The tectum of two of the specimens is as in figure 15C and of the third specimen in figure 15D. The chelicerae appear to be as in the female (Fig. 15J). The chaetotaxy of the palp trochanter, femur and genu is as in figure 15E, and the venter of the gnathosoma is as in figure 15F. The setae of leg I are extremely fine and slender. Those on leg II are a little stouter, especially on the tarsus, and on legs III and IV they are progressively stouter, with those on tarsus IV the heaviest. Tarsus IV bears dorsally a single erect seta *c.*  $110\ \mu\text{m}$  long.

**MALE.** Unknown.

**FEMALE.** The podonotal shield ( $290\text{--}350\ \mu\text{m}$  long  $\times$   $230\text{--}350\ \mu\text{m}$  wide when flattened) is reticulated mainly around the lateral margins. It bears 22 pairs of simple setae in at least three of the specimens examined, as these have *r*<sub>4</sub> situated on the shield. The area posterior to *r*<sub>3</sub> is generally folded ventrally, but Holzmann (1969) figures *r*<sub>4</sub> off the shield. In the specimen figured an additional very slender seta is present on the right side between *s*<sub>5</sub> and *s*<sub>6</sub> (Fig. 15G). Setae *r*<sub>3</sub> are the longest (*c.*  $70\ \mu\text{m}$ ). The opisthonotal shield ( $250\text{--}270\ \mu\text{m}$  long  $\times$   $300\text{--}380\ \mu\text{m}$  wide when flattened) is of similar structure to the podonotal shield and bears 26 pairs of simple setae.

The tritosternum has a narrow base and pilose laciniae and, as in the deutonymph, the presternal shields are extremely small (Fig. 15H). The ventral shields are very weakly sclerotized. The sternal setae are simple, *st.* II and III being stouter than *st.* I. The metasternal, genital and anal setae, together with all eight pairs of opisthogastric setae, are fine and slender. The genital shield is pointed anteriorly. Two conspicuous granular areas may be present in the endogynium.

The trispinate tectum is shown in figure 15I, and the chelicera in figure 15J. The movable digit is  $55\ \mu\text{m}$  long. The gnathosomal setae are rather stout and the posterior hypostomatics tend to be somewhat sinuous (Fig. 15K). The chaetotaxy of the palp femur and genu is as in figure 15L. The leg setae are similar to the deutonymph, but tend to be generally stouter. The long dorsal seta on tarsus IV is *c.*  $95\ \mu\text{m}$ .

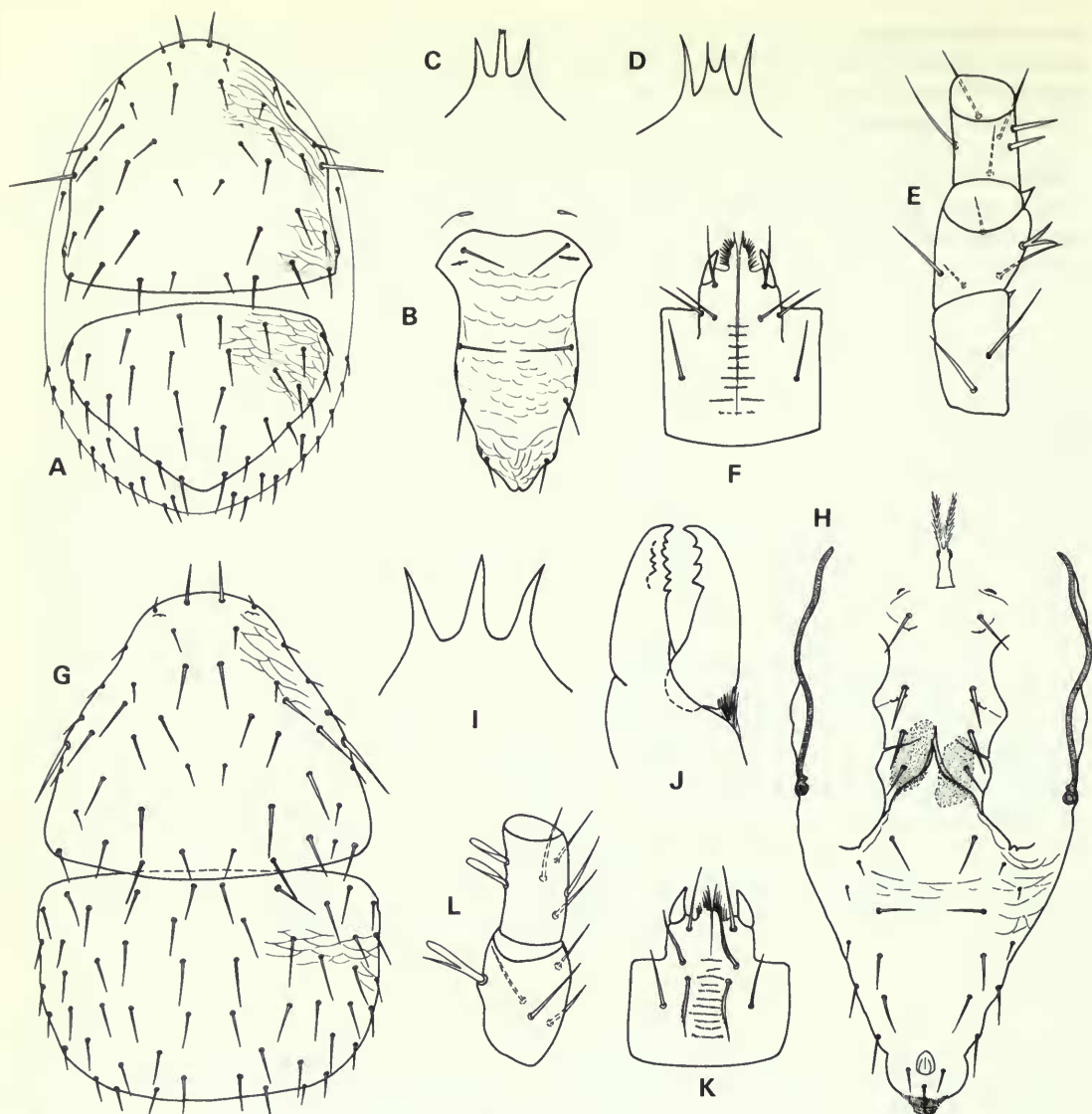


Fig. 15 *Parasitus hyalinus* (Willmann), deutonymph – A dorsum; B sternal shield; C, D tectum; E palp trochanter, femur and genu; F venter of gnathosoma: female – G dorsal shields; H ventral sclerotization; I tectum; J chelicera; K venter of gnathosoma; L palp femur and genu.

MATERIAL EXAMINED. 5 samples – 3 DNN, 17 ♀♀.

ENGLAND: One female from the nest of a sand martin *Riparia riparia*, Send, Surrey, 4 June 1971, two females from manure in a mushroom farm, Tuckton, Hampshire, 7 December 1949, thirteen females from mushroom compost, Nuneaton, Warwickshire, October 1959, one female from grassland, Sutton Bonington, Leicestershire, 21 August 1977, and three deutonymphs from manure heaps, Ivinghoe, Buckinghamshire, 3 March 1962.

IRELAND: In grassland, Johnstown Castle, Co. Wexford (Prof. G. O. Evans, *in litt.*).

DISTRIBUTION. This species is recorded for the first time from the British Isles. It has been found in Poland (Willmann, 1949a, Micherdzinski, 1969) and Germany (Karg, 1965, Holzmann, 1969), in most cases associated with compost.



***Parasitus insignis* (Holzmann)**  
(Fig. 16A–P)

*Eugamasus insignis* Holzmann, 1969: 20.

*Parasitus insignis*: Micherdzinski, 1969: 533. Karg, 1971: 448.

?*Pergamasus* (*Paragamasus*) *diviortus* Athias-Henriot, 1967: 23

*Parasitus* (*Neogamasus*) *diviortus*: Tichomirov, 1971: 804. Bregetova *et al.*, 1977: 75, 77.

Tichomirov (1971) synonymizes *Eugamasus insignis* Holzmann, 1969 and *Parasitus* (*Neogamasus*) *rasumovskyi* Tichomirov, 1969 with *Pergamasus* (*Paragamasus*) *diviortus* Athias-Henriot, 1967. Athias-Henriot (1967), in her observations on *Pergamasus* subgenus *Paragamasus* Hull, 1918, includes *Parasitus islandicus* Sellnick, 1940. Karg (1971) also recognizes that *islandicus* and the related species *Parasitus insignis* Holzmann, 1969 show affinities to both *Pergamasus* and *Parasitus*, but he concludes that they should be placed in *Parasitus*. Tichomirov (1969) designates *islandicus* as the type of his new subgenus *Neogamasus* to which he adds five other species, one of which is *rasumovskyi*.

The species identified here as *Parasitus insignis* (Holzmann) is based on a single female which matches perfectly Holzmann's figures and measurements. For the present I feel that until more material, including males and deutonymphs, can be examined, there is little to be gained in speculating further on the taxonomic position of this specimen.

**DEUTONYMPH.** So far this stage has not been found in the British Isles. Figures 16A–D are from Holzmann (1969) who did not give individual measurements for the podonotal and opisthonotal shields, merely giving the size as  $580 \times 410 \mu\text{m}$ .

**MALE.** This stage also has not been recorded from the British Isles. Figures 16E–I are from Holzmann (1969) who gives the measurements of the idiosoma as  $730 \times 480 \mu\text{m}$ . Karg (1971) illustrates trochanter IV, which bears a small dorsal protuberance as in the female (Fig. 16P).

**FEMALE.** The podonotal shield in the specimen examined measures  $430 \mu\text{m}$  long  $\times$   $430 \mu\text{m}$  wide. It is finely granular, lightly but entirely reticulated, and bears 22 pairs of slender simple setae (Fig. 16J), the longest being *r*3 ( $140 \mu\text{m}$  or longer). Setae *r*4 are situated on the shield. The opisthonotal shield measures  $380 \mu\text{m}$  long  $\times$   $430 \mu\text{m}$  wide. The reticulations are more prominent than on the podonotal shield, and in the anterior half at least, are conspicuously transverse. There are 27 slender simple setae on the left side and 25 on the right.

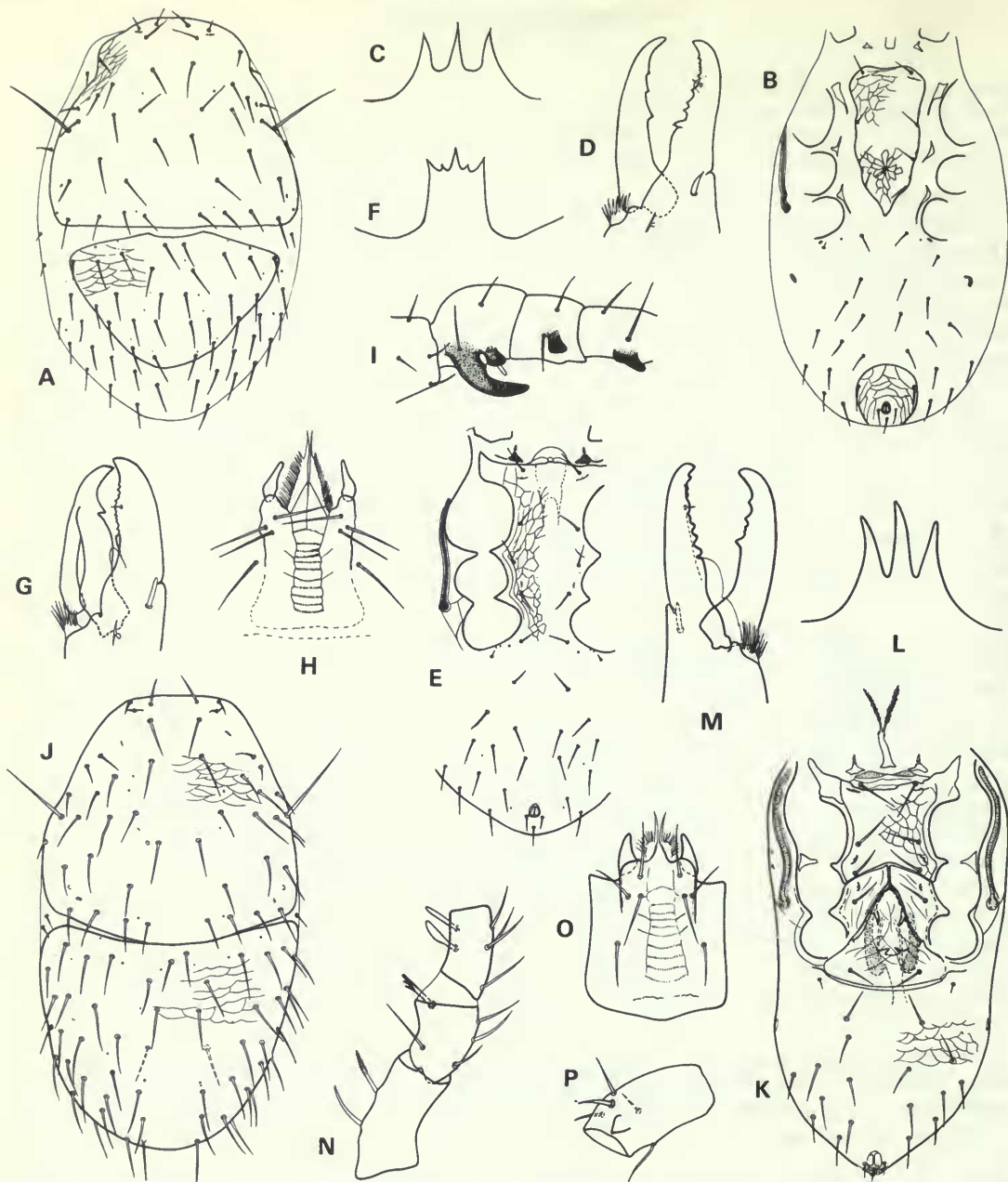
The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of symmetrical and fragmented presternal shields (Fig. 16K). The ventral shields are reticulated, and with the exception of the area anterior to sternal setae I, are densely granular. The opisthogastric area bears ten setae on the left side and nine on the right. All ventral setae are slender and simple. The anal setae are short. The peritreme does not reach coxa I.

The tectum is trispinate with the centre prong only slightly longer than the laterals (Fig. 16L). The chelicera is shown in figure 16M. The teeth on the fixed digit figured do not coincide in position with those on the second chelicera. The chaetotaxy of the palp trochanter, femur and genu is as in figure 16N, and the venter of the gnathosoma in figure 16O. The hypognathal denticles are exceptionally clear and symmetrical. Leg I bears slender setae, a few of which are finely pilose. Leg II bears generally stouter setae, especially on the tarsus, and ventrally on the other segments. Leg III is similar to leg II. Trochanter IV bears a small dorsal protuberance (Fig. 16P), but the remaining segments of both legs IV are missing.

**MATERIAL EXAMINED.** 1 ♀

ENGLAND: A single female from clay loam with rye-grass, Jeallott's Hill, Berkshire, 13 November 1969, coll. W. Wilkinson.

**DISTRIBUTION.** Previously known only from house-plant soil, Erlangen, Germany, where Holzmann (1969) collected many deutonymphs, males and females, this species is recorded from the British Isles for the first time.



**Fig. 16** *Parasitus insignis* (Holzmann), **deutonymph**—A dorsum; B venter; C tectum; D chelicera; **male**—E venter; F tectum; G chelicera; H venter of gnathosoma; I armature of leg II; **female**—J dorsum; K venter; L tectum; M chelicera; N palp trochanter, femur and genu; O venter of gnathosoma; P trochanter of left leg IV from above. A–I after Holzmann, 1969.

***Parasitus kempersi* Oudemans**  
(Figs 17A–M; 18A–F)

*Parasitus kempersi* Oudemans, 1902b: 36. Micherdzinski, 1969: 486. Karg, 1971: 448.

*Parasitus (Coleogamasus) kempersi*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 86, 89.

*Gamasus (Gamasus) kempersi*: Berlese, 1906: 143.

*Eugamasus kempersi*: Holzmann, 1969: 14.

**DEUTONYMPH.** The podonotal shield (430–444  $\mu\text{m}$  long  $\times$  408–480  $\mu\text{m}$  wide) is reticulated and bears 20 pairs of setae, *s2* being situated off the shield. Setae *j1*, *j4*, *z5* and *r3* are long, stout and pointed with very fine pilosity at their tips whilst the remainder are short and fine (Fig. 17A). The opisthonotal shield averages 305  $\mu\text{m}$  long  $\times$  430  $\mu\text{m}$  wide and is also reticulated. It has a conspicuous median mark posteriorly often accompanied by a slight invagination. Fifteen pairs of setae are present of which *Z3* are long and stout and *J5* are thornlike, as are to a certain extent three pairs on the membrane immediately posterior.

The tritosternum is flanked by a pair of slender angular presternal shields. The sternal shield (Fig. 17B) is reticulated and the setae are simple. The anal shield is oval and reticulated with the setae simple, the postanal being the shortest. The opisthogastric setae are generally longer than the setae on the dorsal membrane. The metapodal shields are slender and granular and the peritreme extends to coxa I.

The tectum is trispinate and occasionally the centre prong is irregularly forked (Fig. 17C). The fixed digit of the chelicera bears four or more small teeth and two larger, whilst the movable bears two small teeth and one larger (Fig. 17D). The palp trochanter, femur and genu are shown in figure 17E. The venter of the gnathosoma is as in figure 17F: all setae are simple. The leg setae are almost entirely strong and simple, but tarsus IV bears a stout erect finely pilose seta dorsally.

**MALE.** The dorsum (1044–1100  $\mu\text{m}$  long  $\times$  528–540  $\mu\text{m}$  wide) is completely covered by a lightly reticulated shield which is divided medially by a full-width transverse suture, the two parts often overlapping (Fig. 17G). The podonotal region bears about 22 pairs of setae of which four pairs, *j1*, *j4*, *z5* and *r3*, are long, stout and finely pilose, and three pairs, *z1*, *r2* and *s5* are conspicuously more thornlike than the remaining fine setae. The opisthonotal region bears over 26 pairs of setae of which *Z3* are the stoutest and longest, and *J1*, *J2*, *S2* and several posterior to *Z3* are thornlike, but the remainder are fine and short.

The tritosternum is apparently absent – a fact noted by Halbert (1915) – and the genital lamina extends well forward of the anterior margin of the sternogenital shield. Slender oblique presternal shields are present (Fig. 17H). The venter is lightly reticulated and all setae are slender and fine except for one pair immediately anterolateral to the anus, and also the postanal which is the stoutest and longest. These three setae are finely pilose. The peritreme extends to coxa I.

The tectum is indistinct (Fig. 17I), but nevertheless it scarcely resembles that of the deutonymph or even the female. The chelicera is shown in figure 17J. The movable digit is provided with a row of up to a dozen sharp backwardly-projecting teeth and a second shorter row of similar teeth, whilst the fixed digit has a finely serrated inner margin. The chaetotaxy of the palp trochanter, femur and genu is as in figure 17K. One of the two setae on the trochanter is modified and is stout and bifid. The stalked corniculi are pointed and the internal posterior hypostomatics are considerably longer than the other three pairs of gnathosomal setae (Fig. 17L). The hypognathal denticles are usually indistinct. Leg II is shown in detail in figure 17M. The setae of the remaining legs show no strong characteristics – they are generally strong and the stouter ones are often pilose.

**FEMALE.** The dorsal shields are completely reticulated and their chaetotaxy is the same as in the male (Fig. 17G), except that the membrane posterior to the opisthonotal shield bears setae that in the male are naturally on the shield. The podonotal shield measures 504–540  $\mu\text{m}$  long  $\times$  600–684  $\mu\text{m}$  wide and the opisthonotal shield 540–600  $\mu\text{m}$  long  $\times$  588–636  $\mu\text{m}$  wide.

The tritosternum has a short narrow base and pilose laciniae. Presternal shields are absent. The sternal region is very weakly sclerotized although faint reticulations are present especially in the opisthogastric region (Fig. 18A). The genital shield is pointed medially and the more conspicuous parts of the endogynium are shown. The opisthogastric region bears eight pairs of setae of which six are relatively long and stout. The two marginal pairs nearest the anus are the strongest and, like the postanal seta, and one pair on the adjacent membrane, are finely pilose. The paranals are short and fine. The peritreme extends to coxa I.



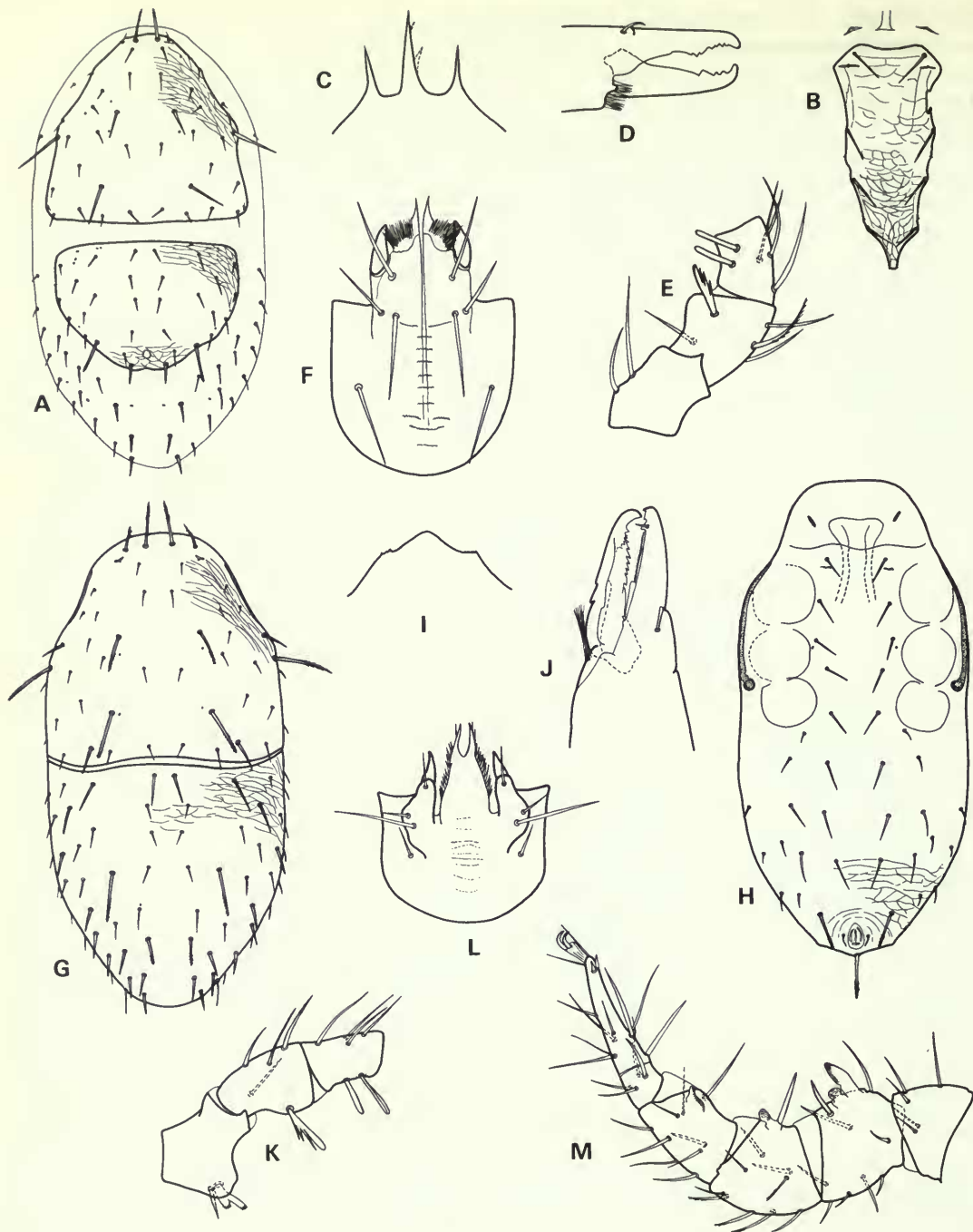


Fig. 17 *Parasitus kempersi* Oudemans, **deutonymph** – A dorsum; B sternal shield; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; **male** – G dorsum; H venter; I tectum; J chelicera; K palp trochanter, femur and genu; L venter of gnathosoma; M leg II.

The tectum is trispinate and shows a certain amount of variation (Figs 18B, C). The chelicera is as in figure 18D. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 18E, and the venter of the gnathosoma in figure 18F. The stout posterior

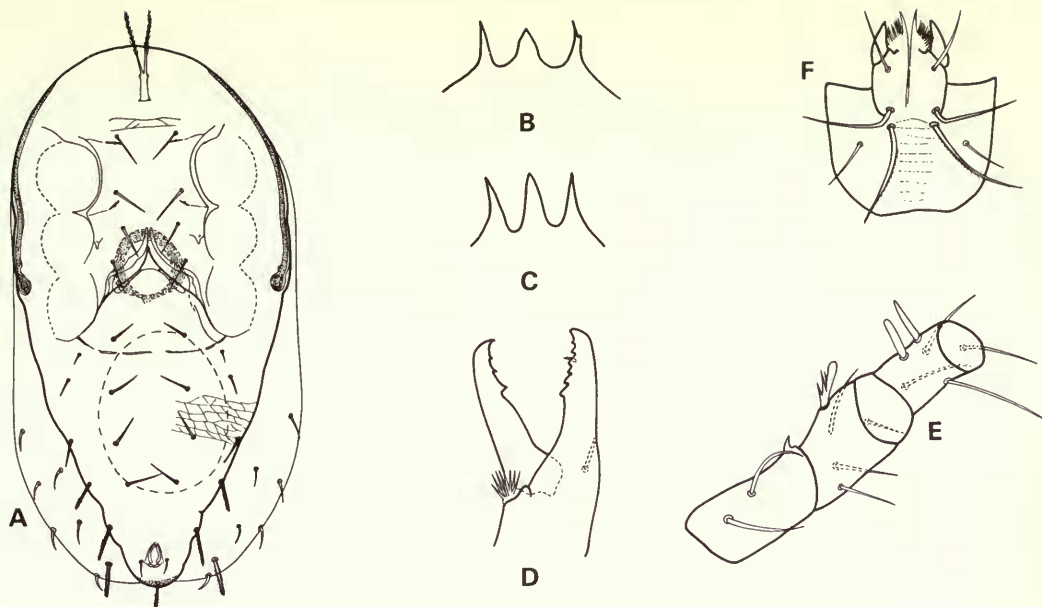


Fig. 18 *Parasitus kempersi* Oudemans, female – A venter; B, C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

hypostomatic setae are the longest and are often bent, but not to the same extent as in *P. fimetorum* (Fig. 14 G). The leg setae are in general shorter than in most species and some dorsal setae on the proximal segments of legs III and IV tend to be peglike.

This species is weakly sclerotized and bursts easily on clearing in lactic acid.

**MATERIAL EXAMINED.** 38 samples – 104 DNN, 88 ♂♂, 94 ♀♀, plus some dozen samples with almost countless deutonymphs, males and females, of which a selection were examined closely.

ENGLAND: Cornwall, Isles of Scilly, south Devon, Dorset, north Kent, Lancashire (Walney Island), Northumberland, Durham.

WALES: Caernarvonshire (Llandudno and Bangor), Anglesey.

SCOTLAND: Argyllshire (Loch Sween), Inverness-shire (Moray Firth coast), Outer Hebrides (Harris).

IRELAND: Cork, Clare.

This often abundant and exclusively seashore species is probably found throughout the British Isles where tidal debris occurs.

**DISTRIBUTION.** Previous British records are from Co. Mayo and Co. Dublin (Halbert, 1915, 1920), Northumberland (Hull, 1918), Devon and Dorset (Evans & Browning, 1954) and Co. Durham (Egglisshaw, 1965). The record of *Parasitus kempersi*, identified by Vitzthum, from Bagley Wood near Oxford (Elton *et al.*, 1931), is clearly a misidentification.

It is recorded from Iceland (Sellnick, 1940), Norway (Berlese, 1906), Holland (Oudemans, 1902*b*), Germany (Willmann, 1939*b*, Neumann, 1941, Holzmann, 1969) and Italy (Berlese, 1906).

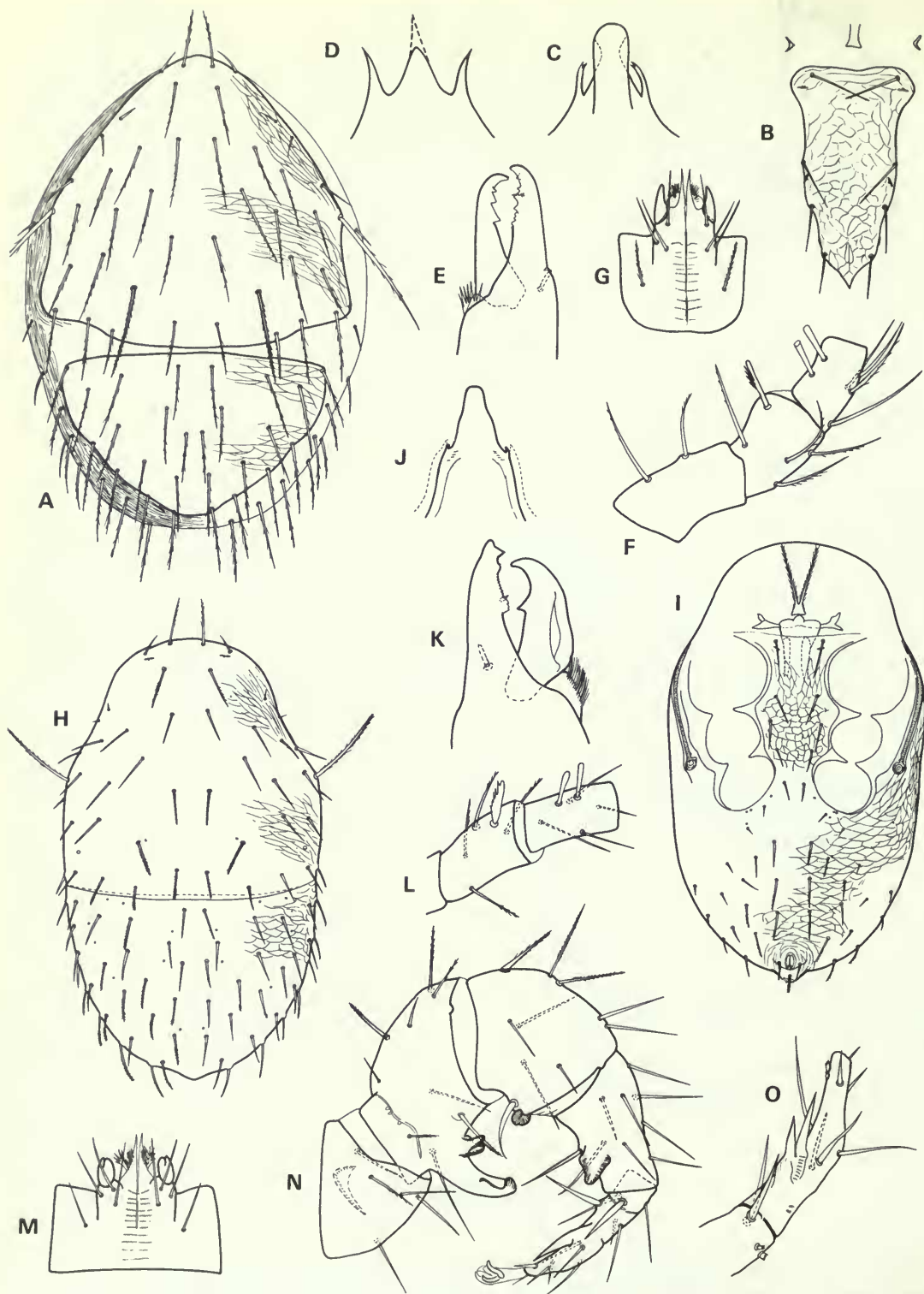
***Parasitus loricatus* (Wankel)**

(Figs 19 A–O; 20 A–G)

*Gamasus loricatus* Wankel, 1861: 261 (♀).

*Eugamasus loricatus*: Oudemans, 1914, Heft 8: 114. Holzmann, 1969: 17. Davydova, 1969: 17, 19.

*Parasitus* (*Eugamasus*) *loricatus*: Tichomirov, 1969: 1475. Davydova, 1976: 41. Bregetova *et al.*, 1977: 65, 69.





*Gamasus niveus*: Wankel, 1861: 262 (♂).

*Eugamasus niveus*: Trägårdh, 1912: 536.

*Parasitus niveus*: Micherdzinski, 1969: 552. Karg, 1971: 448.

*Paracarpais* (*Gigacarpais*) *niveus*: Athias-Henriot, 1978: 48.

*Gamasus crassus* Kramer, 1876: 86.

*Gamasus anglicus* Hull, 1918: 83. Micherdzinski, 1969: 553.

*Eugamasus anglicus*: Turk, 1953: 10.

*Parasitellus ferox* (Trägårdh, 1910) sensu Turk & Turk, 1952: 478 = *Parasitus loricatus* (Wankel, 1861) and *Porrhostaspis lunulata* Müller, 1859, non Trägårdh, 1910 = *Parasitellus fucorum* (De Geer, 1778).

**DEUTONYMPH.** Normally the future adult sex of parasitine deutonymphs can only be determined when the development of the male or female is far enough advanced to be discernible beneath the cuticle of the deutonymph following clearing in lactic acid. At this stage such specific features as the adult chelicerae and tectum, or the gnathosomal setae in the females of *P. fimetorum*, the sternal setae in the females of *P. consanguineus*, and the spur on the palp trochanter of the male of *Vulgarogamasus oudemansi*, are not difficult to see. However, in *P. loricatus* the deutonymphs themselves show sexual dimorphism in the form of the tectum as described below.

The dorsal shields are not heavily sclerotized although they are strongly reticulated and the setae are remarkably homogeneous (Fig. 19A). The podonotal shield (432–516 µm long × 468–576 µm wide) bears 21 pairs of setae which, with the exception of the short *z1*, *s1*, *s2* and *r2*, are all finely pilose and of unusually even length and thickness. However, *j4*, *z5* and *r3* are actually the longest. The opisthonotal shield (276–324 µm long × 400–492 µm wide) bears 13 pairs of setae of even length and the posterior membrane another eight or more similar pairs.

The tritosternum is typical with a narrow base and pilose laciniae. It is flanked by a pair of small v-shaped presternal shields. The sternal shield (283–348 µm long) shows little variation. It is reticulated and the setae are simple (Fig. 19B). The anal shield is oval and reticulated and the three anal setae are simple. Some of the opisthogastric setae are finely pilose. Small circular and granular metapodal shields are present and the peritreme extends to the level of coxa I.

The tectum is trispinate but in two forms, that of the future male (Fig. 19C) and female (Fig. 19D). Oudemans (1914, Heft 8, Taf. III) figures three variations in the male form in which the modified central prong is variously developed, but I have not noted that this variation is so clear cut as to warrant individual attention. Indeed the variation in outline of the tectum in many species is quite extensive. The chelicera is shown in figure 19E and the palp trochanter, femur and genu in figure 19F. The venter of the gnathosoma is as in figure 19G: the palpcoxal setae only appear to be finely pilose. The leg setae show no characteristic formations, although there is one stout seta ventrally on genu II.

**MALE.** The dorsum (1260–1420 µm long × 756–900 µm wide) is strongly sclerotized and entirely reticulated and has a transverse suture medially (Fig. 19H). The podonotal region bears 23 pairs of setae, *r4* being often ventrally situated in mounted specimens. Setae *r3* are the only ones that are conspicuously long, although most are, to some extent, finely pilose. The opisthonotal region bears up to about 26 pairs of setae which are, in general, slightly shorter than the podonotals, but like them are largely pilose.

The tritosternum has a short narrow base and pilose laciniae. It is flanked by granular presternal shields. The genital lamina often protrudes from the sternal shield (Fig. 19I). The ventral sclerotization is reticulated and all setae are fine and slender, some in the

**Fig. 19** *Parasitus loricatus* (Wankel), deutonymph – A dorsum; B sternal shield; C tectum of male deutonymph; D tectum of female deutonymph; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma; male – H dorsum; I venter; J tectum; K chelicera; L palp femur and genu; M venter of gnathosoma; N leg II; O right tarsus of leg II (excluding the ambulatorium) of a Devon specimen (see text, p. 286).

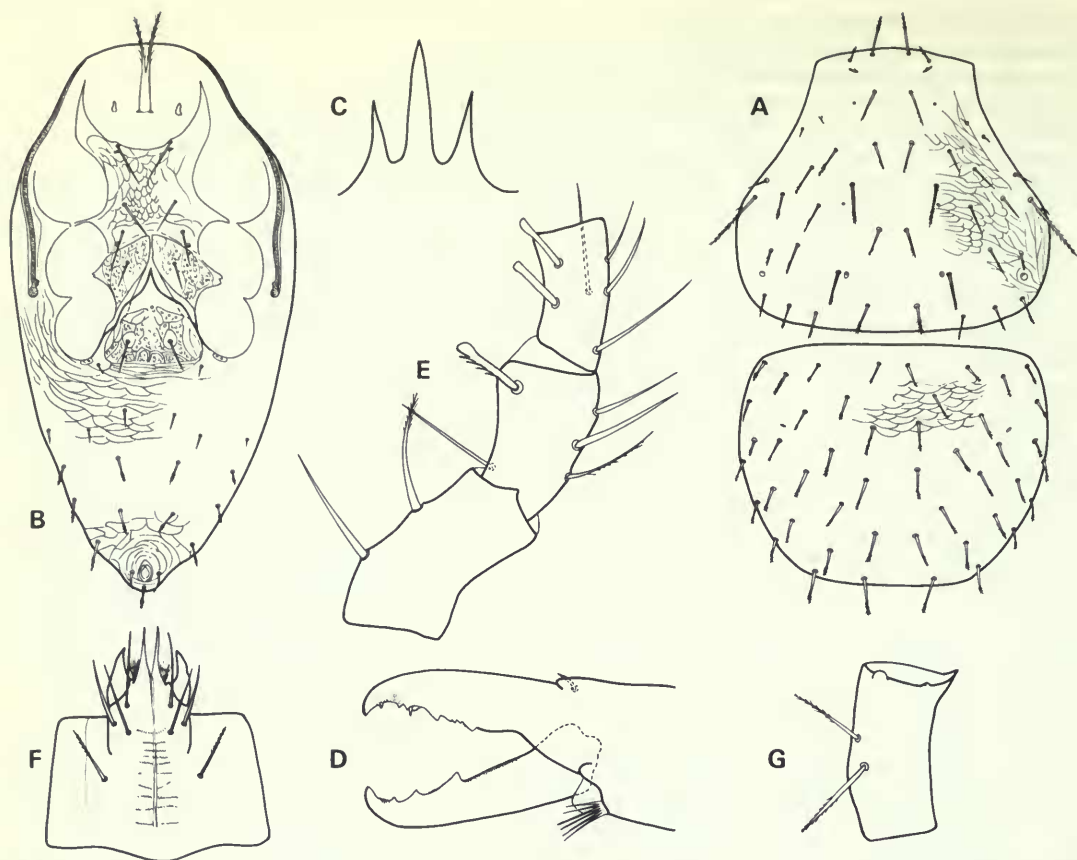


Fig. 20 *Parasitus loricatus* (Wankel), female—A dorsal shields; B ventral sclerotization; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G coxa of leg I.

opisthogastric region being finely pilose. The paranal setae appear simple whilst the postanal is slightly stouter and finely pilose. The peritreme extends anteriorly to coxa I.

The tectum is shown in figure 19J, with variation dotted. The correlation between the tectum in the male deutonymph and adult is clear. The chelicera is shown in figure 19K. The fixed digit bears a ridge of at least 16 very small teeth and the movable digit one large tooth only. The chaetotaxy of the palp femur and genu is as in figure 19L. The stalked corniculi are strongly cleft, the inner portion being rounded, the outer pointed (Fig. 19M). The gnathosomal setae are slender. Leg II is shown in detail in figure 19N. The accessory spur on the femur is strongly bifid, whilst the tarsus is curved to a varying degree. Figure 19O shows the right tarsus II (excluding the ambulacrum) of the specimen from Devon recorded by Turk & Turk (1952) as *Parasitellus ferox*.

**FEMALE.** The dorsal shields are completely reticulated and the chaetotaxy is similar to that of the male. Both shields tend to readily flatten out to their maximum width on clearing and these measurements are given. The podonotal shield (636–768  $\mu\text{m}$  long  $\times$  624–840  $\mu\text{m}$  wide) bears 23 pairs of setae most of which are pilose (Fig. 20A). The opisthonotal shield (544–648  $\mu\text{m}$  long  $\times$  624–840  $\mu\text{m}$  wide) also bears 23 pairs of setae which, as in the male, are slightly shorter than those on the podonotal shield.

The tritosternum has a narrow base and pilose laciniae. The sternal shield is reticulated with a conspicuous pattern and the sclerotization extends laterally and forwards around coxae I (Fig. 20B). The presternal shields are small and crescent shaped. The metasternal and

genital shields are reticulated and are conspicuously ornamented. The sternogenital setae are simple. The opisthogastric region is entirely reticulated and bears nine pairs of setae, some of which appear finely pilose distally, whilst the surrounding membrane has mainly very short setae. The paranal setae are simple, the postanal pilose distally. The peritreme extends to coxa I.

The tectum is boldly trispinate with the centre tine the longest (Fig. 20C), and is clearly correlated with that of the female deutonymph. The chelicera is shown in figure 20D. The inner edge of the movable digit has a conspicuous file-like pattern and the fixed digit has a similar area between the second and third teeth from the tip, a condition that I do not recall seeing in any other species of Parasitinae. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 20E. The corniculi are strong and the gnathosomal setae are of approximately equal length (Fig. 20F). The leg setae are mainly slender and many are finely pilose. Leg II bears a single stout ventral seta on the femur, genu, tibia and tarsus, and on leg III similar setae are present, although on the genu and tibia these are paired. Leg IV bears a single stout ventral seta on each segment from trochanter to tibia. Coxa I bears a tooth on the inner distal margin (Fig. 20G).

**MATERIAL EXAMINED.** 130 samples – 174 DNN, 86 ♂♂, 142 ♀♀.

**ENGLAND:** Isles of Scilly, Devon, Somerset, Hampshire, Gloucestershire, Wiltshire, Berkshire, Oxfordshire, Middlesex, Hertfordshire, London, Essex, Kent, Surrey, Suffolk, Cambridgeshire, Huntingdonshire, Worcestershire, Staffordshire, Lincolnshire, Derbyshire, Cheshire, Manchester, Cumberland, Yorkshire, Northumberland, Durham.

**WALES:** Breconshire.

**SCOTLAND:** Roxburghshire, Midlothian, West Lothian, Argyllshire (Lismore, Shuna), Inner Hebrides (Scalpay), Outer Hebrides (Lewis).

**IRELAND:** Cork, Meath.

This widespread European species is distributed throughout the British Isles. Its favoured habitats are, like several other *Parasitus*, compost and dung heaps, rotting vegetation, mushroom beds, small mammal nests (especially voles, moles and shrews), birds' nests in burrows or holes in trees, and in caves. Additionally, situations such as on house-mouse and brown rat, wasp and bumblebee are recorded. I have examined only four samples from leaf-litter where there was no obvious host in the immediate vicinity (Isles of Scilly and Staffordshire). Abroad it is recorded from similar habitats and Karg (1971) notes that it is scarce in arable soil although a few such records are quoted by Micherdzinski (1969).

**DISTRIBUTION.** Previous British records are from Yorkshire and Lancashire (*anglicus*) and Middlesex and Scotland (Hull, 1918), Berkshire\* (Elton *et al.*, 1931), Somerset\*\* (Turk, 1944), Devon (Turk & Turk, 1952, misidentified as *Parasitellus ferox* (Träg.)), Buckingham Palace Gardens, London (Bristowe, 1964), Cambridgeshire, Worcestershire and Wigtownshire (Mead-Briggs & Hughes, 1966), Huntingdonshire (Davis, 1970), and Yorkshire, Devonshire and Breconshire (Turk, 1972). Turk (1967) lists this species as a cave inhabitant without citing localities. In the same paper he also cites *Parasitellus ferox* (Trägårdh), which presumably refers to the Devon material referred to above (Turk & Turk, 1952). Other cave records are Devon (Hazelton, 1967*a, b*, 1970*a*), Somerset (Hazelton, 1967*a, c*, 1968*a, c*), Wiltshire (Hazelton, 1971*b*), Breconshire (Hazelton, 1971*a, b*), Derbyshire (Hazelton, 1972), Cumberland (Hazelton, 1967*a*, 1972) and Yorkshire (Hazelton, 1970, 1972). The mention by Micherdzinski (1969) of this species being recorded, as *Gamasus crassus* Kramer, from the London area by Michael (1892) is based on his erroneous translation of Michael's introductory remarks. The specimens in question were from Switzerland.

\*A single slide in the Museum Collection of a male deutonymph of this species from a dead bank-vole *Clethrionomys glareolus* (Schreber), Bagley Wood, Berkshire, 8 February, 1926, and identified by Vitzthum as '*Parasitus spinipes* Koch' is most probably part at least of the material forming the record by Elton *et al.* (1931) of '*Parasitus spinipes* Oudemans'. A second slide, bearing the same habitat data, but identified by Vitzthum as *Eugamasus magnus* Kramer, is of a male deutonymph of *P. loricatus*, collected on 10 December, 1925.

\*\*Micherdzinski (1969) misquotes Turk (1944) and cites the Mendip Hills as being in Derbyshire.



When Hull (1918) described *Gamasus anglicus* from Yorkshire (W. Falconer) and Lancashire (Rev. S. G. Birks) he listed *Gamasus loricatus* Wankel as 'A species unknown to me'. Nevertheless, his figures of *anglicus*, and especially leg II of the male, leave no doubt that the new species is synonymous with *loricatus* and it is treated as such by Micherdzinski (1969). I have examined a single male from Brantingham Dale, Brough, Yorkshire, 11 April 1916, in the Falconer Collection at Liverpool Museum, and this is probably the material upon which Hull based his record. However, the specimen is *Euryparasitus emarginatus* (C. L. Koch), family Rhodacaridae, and it is clear from the label that this was its original identification under the junior synonym of *Euryparasitus terribilis* (Michael). But, the original identification has been crossed out and '♂ *Gamasus anglicus*' inserted in either Hull's or Falconer's writing. Hull's record from Lancashire almost certainly refers to a sample (1 ♂, 2 ♀♀ and 5 DNN) in the Hull Collection from Holy Trinity Churchyard, Darwen, Lancashire, 6 January 1916, S. G. Brade-Birks coll., and these specimens are *Parasitus loricatus*.

*Parasitus loricatus* is recorded from the Faeroes (Trägårdh, 1931), Iceland (Sellnick, 1940), Sweden (Lundqvist, 1974), Finland (Nordberg, 1936), Holland (Oudemans, 1914), Belgium (Willmann, 1935, Leruth, 1939, van Daele & Heungens, 1974), France (Bonnet, 1911, Trägårdh, 1912, Cooreman, 1959), Germany (Kramer, 1876, Oudemans, 1930b, Willmann, 1932a, 1937, 1938b, 1952, Karg, 1965, 1971, Holzmann, 1969), Spain (Trägårdh, 1912), Austria (Franz, 1943), Switzerland (Cooreman, 1959, Schweizer, 1922, 1949, 1961), Italy (Cooreman, 1959), Poland (Pax & Maschke, 1935, Willmann, 1936a, Kielczewski, 1957, Micherdzinski, 1969), Czechoslovakia (formerly Austria, Wankel, 1861; Pax & Maschke, 1935, Maschke, 1936, Willmann, 1954), Yugoslavia (Willmann, 1932b), Romania (Coorman, 1951b), U.S.S.R. (Pinchuk, 1976), Western Siberia (Davydova, 1969, 1976) and Morocco (Cooreman, 1951a).

#### *Parasitus mustelarum* Oudemans

(Fig. 21A–P)

*Parasitus mustelarum* Oudemans, 1902b: 9, 33 *nomen nudum*; 1903b: 85; 1905a: 78; 1912c: 260.

Karg, 1965: 232, 239, 245; 1971: 448. Micherdzinski, 1969: 444.

*Parasitus (Coleogamasus) mustelarum*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 85, 91.

*Gamasus coleopratorum* L.: Berlese, 1882c: 120 ('tritonymph').

*Gamasus intermedius* Berlese, 1904a: 240. Micherdzinski, 1969: 450.

*Gamasus (Gamasus) intermedius*: Berlese, 1906: 152.

*Eugamasus intermedius*: Holzmann, 1969: 14.

Berlese (1906), Oudemans (1912c), Holzmann (1969) and Karg (1971) all consider *intermedius* Berlese to be synonymous with *mustelarum* Oudemans, whilst Micherdzinski (1969) feels that they are distinct species, being differentiated above all on the form of the tectum. I have examined specimens of *mustelarum* in the Oudemans collection and consider the British material documented here to be conspecific with it. Berlese (1906) considered *intermedius* to have priority over *mustelarum* but he overlooked Oudemans's (1903b) description of the deutonymph of *mustelarum*, as has already been pointed out by Oudemans (1912c).

**DEUTONYMPH.** The forty specimens examined in the present study show the least variation of any species or developmental form. The dorsum is entirely covered by two moderate to strongly sclerotized reticulated shields whose chaetotaxy is shown in figure 21A. The podonotal shield (420–444 µm long × 420–456 µm wide) bears 20 pairs of setae, *s2* being situated off the shield. The majority of setae are short and rather spinose, but four pairs are conspicuously longer. Setae *r3* are the longest and are pilose for most of their length, whilst *z5* are almost as long and are pilose in their distal halves. Setae *j1* and *j4* are also longer than the majority and are pilose distally. The opisthonotal shield (276–288 µm long × 360–396 µm wide) bears 17 pairs of setae of which one pair only, *Z3*, are stout and pilose distally.

The tritosternum has a narrow base and pilose laciniae. It is flanked by wide shallow presternal shields. The strongly sclerotized sternal shield (360–396 µm long) is of

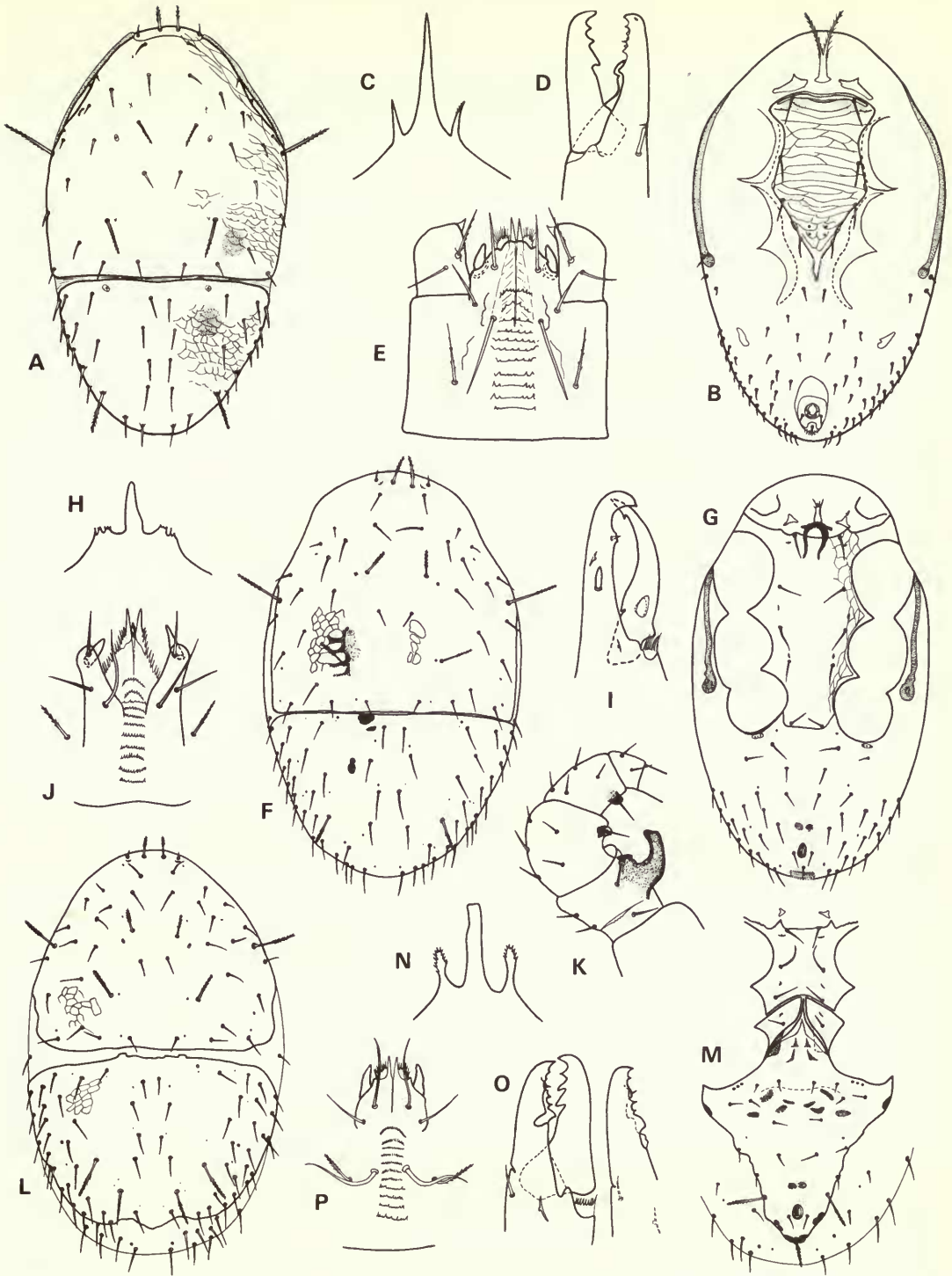


Fig. 21 *Parasitus mustelarum* Oudemans, deutonymph - A dorsum; B venter; C tectum; D chelicera; E venter of gnathosoma: male - F dorsum; G venter; H tectum; I chelicera; J venter of gnathosoma; K armature of leg II: female - L dorsum; M ventral sclerotization; N tectum; O chelicera; P venter of gnathosoma. F-P after Holzmann, 1969.

characteristic outline and is attenuated posteriorly between coxae IV. A narrow transverse strip passing through sternal setae I is weakly sclerotized (Fig. 21B). The sternal setae become progressively shorter from I–IV and the opisthogastric setae, which number approximately 31 pairs, are shorter still. The anal shield is elliptical with the three setae short and simple. The peritreme extends to coxa I.

The tectum is as in figure 21C. The centre prong is often broken short. The chelicera is shown in figure 21D, and the venter of the gnathosoma and the palp trochanter in figure 21E. The anterolateral seta on the palp femur is simple and tapered, whilst those of the palp genu are flattened distally. All leg setae are rather short and spinelike and some are finely pilose distally.

**MALE AND FEMALE.** So far the adults have not been collected in the British Isles. Figures 21F–K of the male and 21L–P of the female are based on Holzmänn (1969). The idiosoma of the male measures *c.* 900  $\mu\text{m}$  long  $\times$  480  $\mu\text{m}$  wide, and the female 900–990  $\mu\text{m}$  long  $\times$  560–635  $\mu\text{m}$  wide.

**MATERIAL EXAMINED.** 12 samples – 40 DNN.

ENGLAND: Isles of Scilly, Dorset, Hampshire, Norfolk, Worcestershire, Yorkshire.

With the exception of three deutonymphs that were found on piglets in Norfolk and Yorkshire, all the material examined is from beetles, viz.: *Geotrupes spiniger* (Marsham) and *stercorarius* (L.), *Aphodius* sp. and ?*Colobopterus fossor* (L.).

**DISTRIBUTION.** The only previous British record of this species is from *Geotrupes stercorarius* at Wareham, Dorset, 7 October 1958 (Hyatt, 1959) ('*Parasitus* nr. *intermedius*'). The females recorded from Cheshire as *Parasitus intermedius* (Berlese) by Turk & Turk (1952) are *Vulgarogamasus kraepelini*.

It is recorded from Norway (Berlese, 1906), Holland (Oudemans, 1902*b*), Germany (Holzmänn, 1969, Micherdzinski, 1969, Karg, 1971), Austria (Leitner, 1946), Poland (Micherdzinski, 1969), Switzerland (Schweizer, 1949), Italy (Berlese, 1906) and Western Siberia (Davydova, 1976). Habitats are beetles, straw, dung, compost, fungi and occasionally associated with small mammals.

The species referred to as *Parasitus cf. intermedius* by Costa (1966) is not conspecific with *P. mustelarum*.

#### Genus *VULGAROGAMASUS* Tichomirov

*Vulgarogamasus* Tichomirov, 1969. *Zool. Zh.* **48**: 1335.

**TYPE SPECIES.** *Parasitus burchanensis* Oudemans, 1903*b*.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields. Setae of dorsal hexagon very similar in form and length, deutonymphs with *z5* sometimes clearly the longest. Tritosternum normal, biramous. Junction between sternal and metasternal shields of female oblique. Genital shield of female triangular or subtriangular. Opisthogaster with rarely more than 26 pairs of setae. Seta *al* of palp femur multifid or pectinate or scalloped distally; setae *al*<sub>1</sub> and *al*<sub>2</sub> of palp genu entire, spatulate. Male chelicerae symmetrical. Corniculi short, entire. Legs of deutonymph and female without spurs; only leg II of male spurred. Lobes of pulvilli normal, rounded.

#### *Vulgarogamasus burchanensis* (Oudemans) (Figs 22A–H; 23A–G)

*Parasitus burchanensis* Oudemans, 1903*b*: 86; 1905*a*: 80. Berlese, 1906: 134. Sellnick, 1940: 51. Micherdzinski, 1969: 565. Karg, 1971: 449. Type examined.

*Parasitus (Vulgarogamasus) burchanensis*: Tichomirov, 1969: 1335, 1476. Bregetova *et al.*, 1977: 80, 81.

*Vulgarogamasus burchanensis*: Evans & Till, 1979: 210.



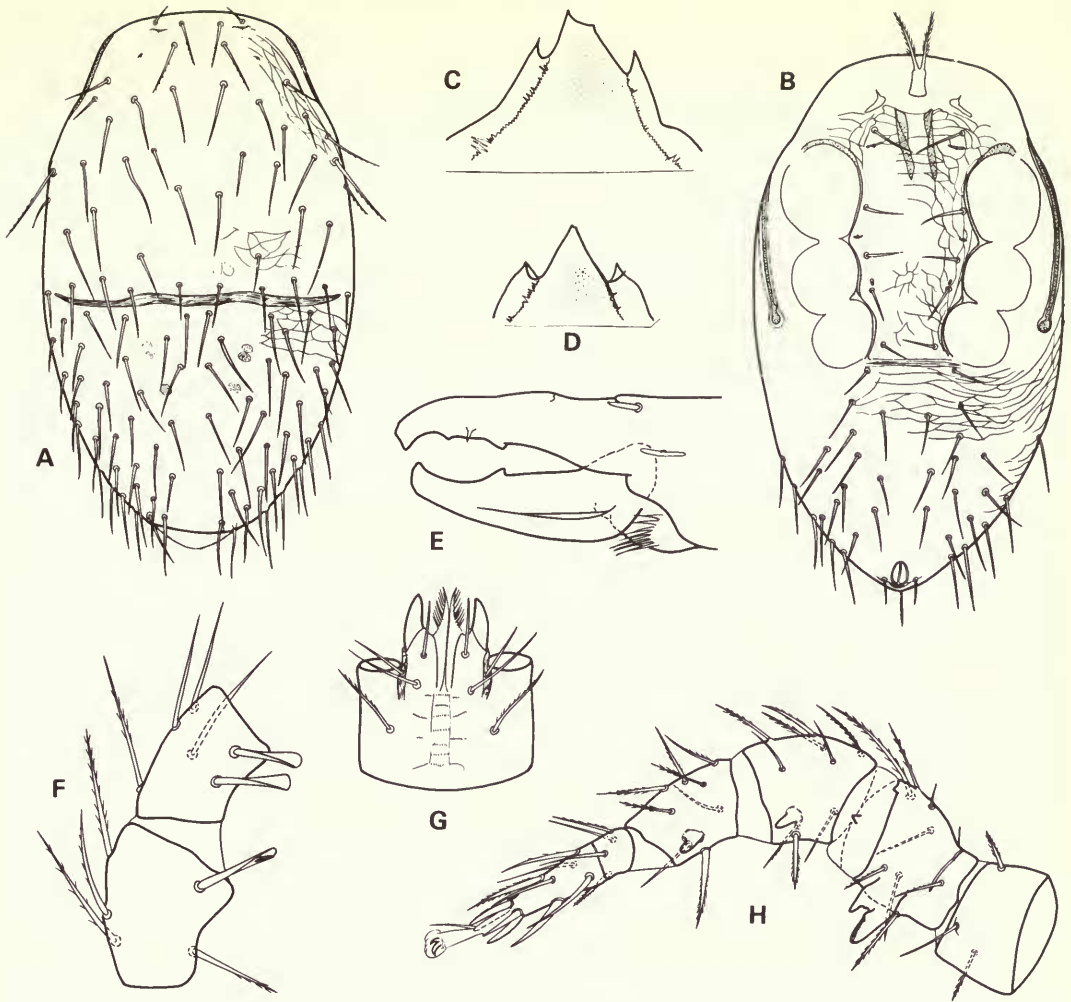


Fig. 22 *Vulgarogamasus burchanensis* (Oudemans), male – A dorsum; B venter; C, D tectum; E chelicera; F palp femur and genu; G venter of gnathosoma; H leg II.

*Eugamasus butleri* Hughes, A. M., 1948: 121; 1961: 207; 1976: 350. Hughes, T. E., 1959: 150. Micherdzinski, 1969: 551. Tichomirov, 1969: 1335. Type examined.

*Eugamasus butleri* Hughes has been synonymized with *Parasitus burchanensis* Oudemans by Tichomirov (1969) in the course of designating *burchanensis* as the type of his new subgenus *Vulgarogamasus*. I have examined Oudemans's type male and agree that it is synonymous with syntype males of *butleri*. The female figured and identified as *burchanensis* by Sellnick (1940) is considered here to be conspecific with the syntype female of *butleri*.

DEUTONYMPH. Unknown.

MALE. The dorsums of two syntype males of *Eugamasus butleri* measure 680–700  $\mu\text{m}$  long  $\times$  430–440  $\mu\text{m}$  wide and are entirely sclerotized and reticulated and each is divided by a median transverse suture (Fig. 22A). The podonotal region bears 23 pairs of setae although in the specimen figured the left *r2* is missing. All setae are slender and several are finely pilose on one margin, and *r3* are scarcely longer than the majority. The opisthonotal region bears about 35 pairs of longish slender setae.

The tritosternum has a narrow base and pilose laciniae. It is flanked by elongate presternal shields (Fig. 22B). The sternogenital and opisthogastric regions are well sclerotized and reticulated and all setae are fine and simple. The postanal seta is finely pilose and is slightly longer than the paranals. The peritreme extends to coxa I.

The tectum comprises a broadly triangular plate, sometimes irregularly formed, with a pair of lateral teeth. Additionally two diverging rows of fine sawlike teeth run back from the basal angles of the centre prong. Its surface is granular (Figs 22C, D). The chelicera is as in figure 22E. The chaetotaxy of the palp femur and genu is shown in figure 22F, and the venter of the gnathosoma in figure 22G. The palpcoxal setae are pilose, the hypostomatics simple. Legs I, III and IV bear mainly simple setae, those on the posterior legs being stoutest. Leg II is shown in figure 22H.

**FEMALE.** The podonotal shield of the single syntype female of *Eugamasus butleri* examined measures 372  $\mu\text{m}$  long  $\times$  396  $\mu\text{m}$  wide (Fig. 23A). It is finely granular and lightly reticulated and bears 22 pairs of setae of which *j1* are finely pilose and some others scarcely so. Setae *r3* are the longest but only slightly. The opisthonotal shield measures 312  $\mu\text{m}$  long  $\times$  408  $\mu\text{m}$  wide, is finely granular and lightly reticulated. It bears 26 simple setae on the left side and 27 on the right. The posterior membrane bears 9 or 10 pairs of setae of similar length which show slight pilosity.

The tritosternum has a narrow base and pilose laciniae. Contiguous with its base is a pair of fragmentary presternal shields and more laterally the main presternal shields (Fig. 23B). Sternal setae I lie on an area of reticulation which is more weakly sclerotized than the main part of the sternal shield. The sternal, metasternal and genital shields are granular, the setae fine and simple. The main part of the endogynium is circular and sac-like. The opisthogastric shield is irregular in outline and the anal region is almost separated. The opisthogastric setae are simple whilst the postanal seta is slightly longer than the paranals. The metapodal shields are represented by small granular circles. The peritreme extends to coxa I.

The tectum is shown in figure 23C, the chelicera in figure 23D, the palp trochanter, femur and genu in figure 23E, and the venter of the gnathosoma in figure 23F. The leg setae do not appear to exhibit any peculiarities. In the syntype examined femur II has a pronounced sclerotized ridge anterodorsally (Fig. 23G), but this is not present in the specimen from Lanarkshire.

**MATERIAL EXAMINED.** 2 samples – 2  $\sigma\sigma$ , 2  $\text{♀♀}$ .

SCOTLAND: One female from deep litter in a poultry-house, Lanarkshire, 1977.

IRELAND: Two males and one female from the syntype series of *Eugamasus butleri* in floor sievings from brewers' grain, Belfast.

**DISTRIBUTION.** Other British records (as *E. butleri*) are from poultry litter in Cambridgeshire (Brady, 1970 and pers. comm.) and from farms, flour mills and railway wagons in the Republic of Ireland (no precise localities) (Cusack, Evans & Brennan, 1975).

It has been recorded from the German North Sea island of Borkum (Oudemans, 1903b, 1905a) (no habitat given) and from Iceland (Sellnick, 1940) in a barn/granary ('Scheune') and in dry grass and old hay.

***Vulgarogamasus immanis* (Berlese)**  
(Figs 24A–O; 25A–G)

*Gamasus* (*Eugamasus*) *immanis* Berlese, 1904a: 262; 1906: 179.

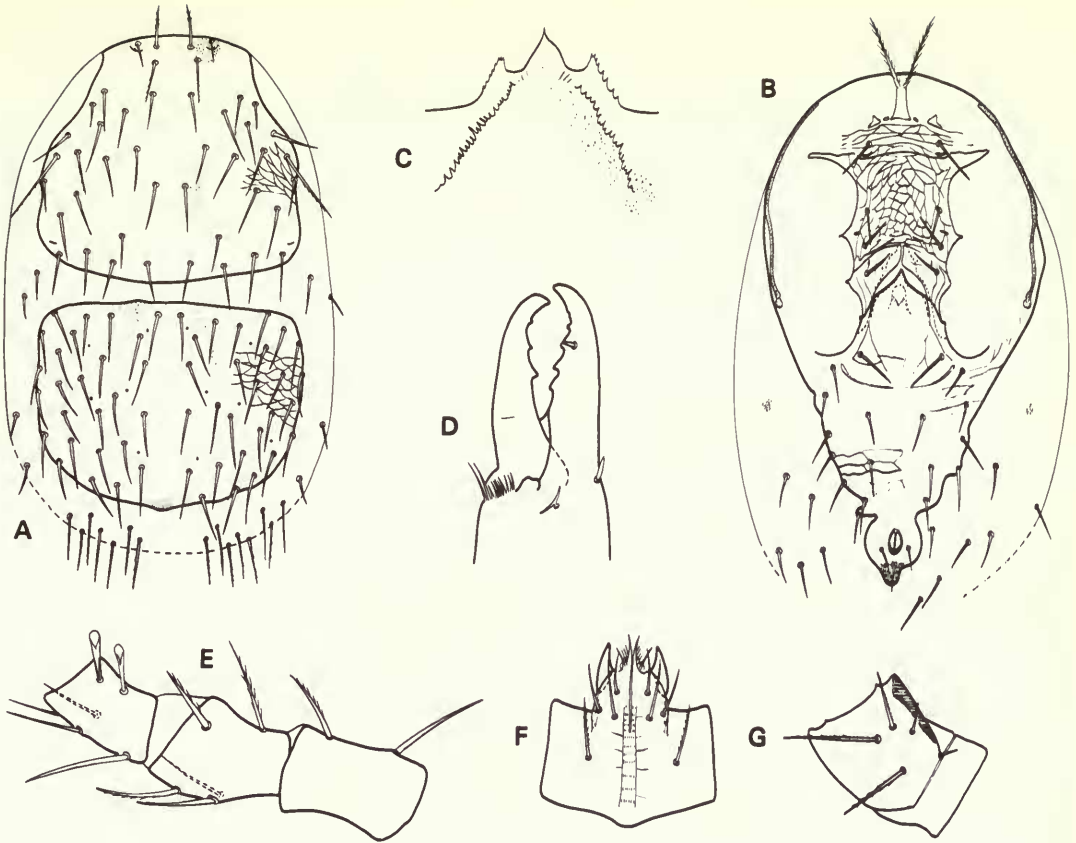
*Eugamasus immanis*: Sellnick, 1940: 49.

*Parasitus immanis*: Micherdzinski, 1969: 515. Karg, 1971: 446.

*Parasitus* (*Vulgarogamasus*) *immanis*: Tichomirov, 1969: 1336, 1476. Bregetova *et al.*, 1977: 80, 81.

*Vulgarogamasus immanis*: Evans & Till, 1979: 210.

**DEUTONYMPH.** The dorsal shields are considerably smaller than the idiosoma and are entirely covered by a pattern of small reticulation and areas of fine granulation (Fig. 24A).



**Fig. 23** *Vulgarogamasus burchanensis* (Oudemans), **female** – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G femur of leg II.

The podonotal shield (830–880  $\mu\text{m}$  long  $\times$  630–700  $\mu\text{m}$  wide) bears, in the specimens examined, from 15–17 pairs of setae. In the figured specimen the left side has 17 setae and the right side has 15. In other specimens, one or more of the lateral setae are located on a piece of shield that is almost separated from the margin but has clearly not been damaged. Setae  $r3$  (c. 270  $\mu\text{m}$ ) are the longest and are situated on small granular plates separate from the podonotal shield, whilst  $z5$  (c. 160  $\mu\text{m}$ ) are only slightly longer than the remainder which range from c. 100–150  $\mu\text{m}$ . All setae are simple. The opisthonotal shield (500–550  $\mu\text{m}$  long  $\times$  480–550  $\mu\text{m}$  wide) bears from 11–15 pairs of setae which are often unpaired on the posterior margin. The figured specimen bears 13 pairs. The surrounding membrane bears setae of similar lengths.

The tritosternum has a narrow base and pilose laciniae, and the presternal shields are small and triangular. The reticulated sternal shield is of somewhat irregular but characteristic outline (Fig. 24B), and ranges from 510–540  $\mu\text{m}$  in length. The opisthogastric setae are simple and small granular metapodal shields are present. The reticulated anal shield varies rather in outline but always carries an additional pair of setae towards its anterior margin. The postanal seta is longer than the paranals. The peritreme does not quite reach coxa I.

The tectum is denticulate and of a constant general form comprising a central elongate area and two strongly denticulate lateral areas, but there is frequent variation, especially in the form of the central area (Figs 24C, D). The chelicera is shown in figure 24E. The digits are slender and the movable measures c. 275  $\mu\text{m}$ . The palp trochanter, femur and genu are shown in figure 24F. The gnathosomal setae are slender and simple and sixteen or more rows



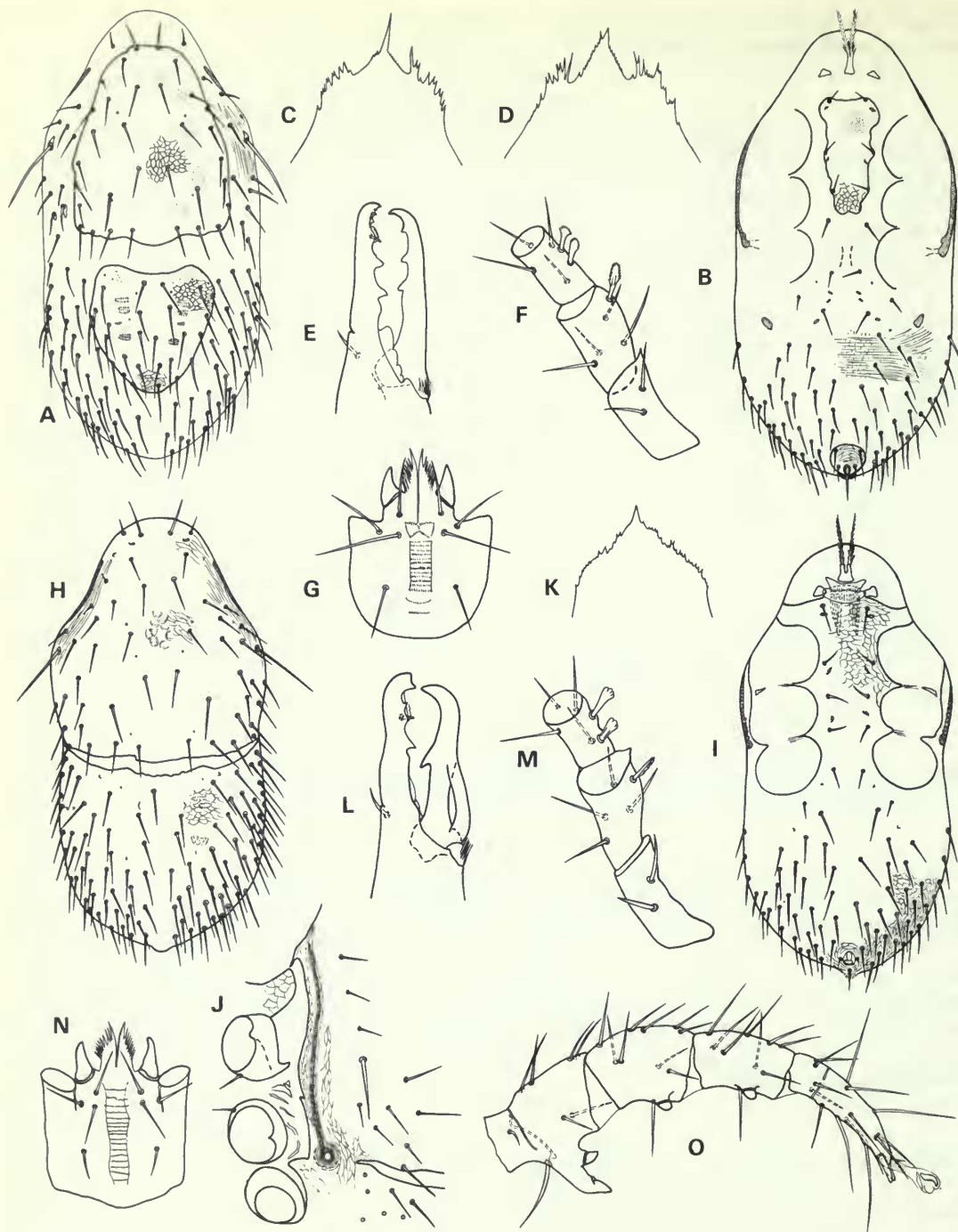


Fig. 24 *Vulgarogamasus immanis* (Berlese), deutonymph – A dorsum; B venter; C, D tectum; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma: male – H dorsum; I venter; J peritreme in detail; K tectum; L chelicera; M palp trochanter, femur and genu; N venter of gnathosoma; O leg II.

of hypognathal denticles are present. The corniculi are strong and smooth (Fig. 24G). The leg setae are all slender and tarsus IV bears dorsally two conspicuously long setae measuring *c.* 350–400  $\mu\text{m}$ .

**MALE.** The dorsum is entire and averages 2160–2250  $\mu\text{m}$  long  $\times$  1110–1130  $\mu\text{m}$  wide. It is strongly sclerotized, finely reticulated and with a broad transverse suture (Fig. 24H). The podonotal region bears about 25 pairs of simple setae not arranged entirely symmetrically. Seta *s1* at least may not be paired (as in the figured specimen), and the longest setae are *r3* (*c.* 300  $\mu\text{m}$ ). The opisthonotal region bears over 40 pairs of setae, but here again they are neither entirely symmetrically arranged nor paired.

The tritosternum has a rather short narrow base which appears to be extensible, and pilose laciniae (Fig. 24I). A pair of small presternal shields is present. The entire venter is very strongly sclerotized and finely reticulated. The setae are slender and simple. The postanal seta is longer than the paranals. The peritreme extends almost to coxa I and is shown in detail in figure 24J.

The tectum is shown in figure 24K. Variation noted is in the form of the denticulations, but the general theme is constant. The chelicera is shown in figure 24L. The movable digit measures *c.* 310  $\mu\text{m}$ . The chaetotaxy of the palp trochanter, femur and genu is as in figure 24M. The corniculi taper and are divergent and the gnathosomal setae are slender (Fig. 24N). The leg setae are simple and slender and tarsus IV bears dorsally two conspicuously long setae measuring *c.* 360  $\mu\text{m}$  each. Leg II is shown in detail in figure 24O.

**FEMALE.** The podonotal shield (1270–1340  $\mu\text{m}$  long  $\times$  1110–1210  $\mu\text{m}$  wide) is strongly sclerotized and granular and with conspicuous areas of circular punctations (Fig. 25A). It bears 23 pairs of simple setae of which the longest are *j4* (160  $\mu\text{m}$ ) and *r3* (*c.* 240  $\mu\text{m}$ ) and their arrangement is more symmetrical than in either the deutonymph or the male. The opisthonotal shield (840–1010  $\mu\text{m}$  long  $\times$  970–1050  $\mu\text{m}$  wide) is of similar form to the podonotal and bears 22 pairs of simple setae. The surrounding membrane bears slightly shorter setae.

The tritosternum has a short narrow base and pilose laciniae. It is flanked by a pair of conspicuous presternal shields (Fig. 25B). The sternal shield is granular and entirely reticulated, but its anterior margin is indistinct. The genital shield is triangular and granulate. Figure 25C shows the genital region in greater detail. The opisthogastric shield is strongly granulate on the surface with reticulations below. Its margin is irregular in places and the anal region is almost cut off. In the specimen figured one of the adjacent short interscutal setae is on a small granular plate and a second seta lies on a narrow granular strip close to the anus. The three anal setae are of almost equal length. The peritreme does not reach coxa I.

The tectum is basically of the same form as in the deutonymph and male, but in the figured specimen the denticulations are less developed or even broken off (Fig. 25D). The chelicera (Fig. 25E) is again long and slender and the movable digit measures *c.* 400  $\mu\text{m}$ . The palp trochanter, femur and genu are shown in figure 25F, and the venter of the gnathosoma in figure 25G. The corniculi are shaped as in the male and are very slightly divergent. The gnathosomal setae are simple. All leg setae are simple and tarsus IV bears dorsally at least two setae measuring *c.* 300  $\mu\text{m}$ .

**MATERIAL EXAMINED.** 4 samples – 7 DNN, 8 ♂♂, 3 ♀♀.

**ENGLAND:** One male from Ringstead Bay, Dorset, 1 November 1911, coll. H. St. J. K. Donisthorpe.

**SCOTLAND:** One male and one female from the Edinburgh district (Firth of Forth), 1905, coll. Wm. Evans.

**WALES:** Seven deutonymphs, six males and two females from seaweed on the shore of the Menai Straits, Caernarvonshire, 23 August 1976, coll. Mrs M. J. Morgan.

**DISTRIBUTION.** The first published British record of this species is that of Berlese (1906) who examined two specimens from Ireland sent to him by Halbert. King (1912) recorded it from

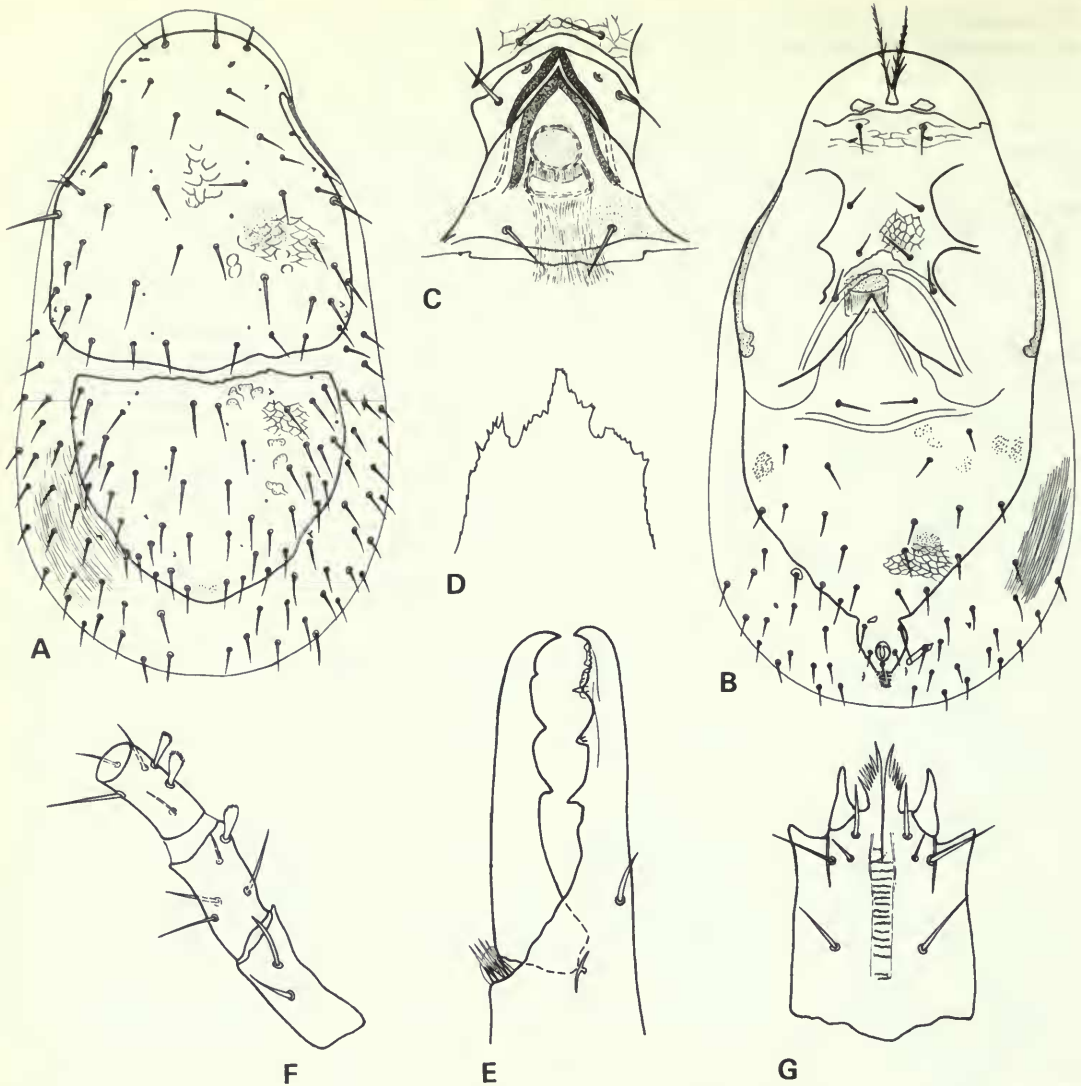


Fig. 25 *Vulgarogamasus immanis* (Berlese), female – A dorsum; B venter; C genital region; D tectum; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma.

the Firth of Clyde and later (King, 1914), whilst recording it additionally from Dunbartonshire, he described in some detail his field and laboratory observations on specimens obtained in the Firth of Clyde. In his 1914 paper King referred to Berlese's (1906) Irish record as 'Iceland'. This had already been referred to by Sellnick (1940: 50) and is explained by the fact that Berlese wrote '*duasque in "Islanda", (quas mihi misit cl. Halbert)*'. Berlese made a similar statement when he described the oribatid mite *Lohmannia insignis* (Berlese, 1904c: 23) as '*Hibernia collecta*' and wrote on at least one of Halbert's labels '*Lohmannia insignis* Berl. Islanda'. Subsequent British records are from Co. Mayo, Co. Cork and Co. Dublin (Halbert, 1915), Co. Galway (Halbert, 1920) and Northumberland and Lancashire (Hull, 1918).

It is recorded from Iceland (Sellnick, 1928, 1940) and Norway (Berlese, 1904b).

The sparsity of records of this species is at first surprising in view of its size. I had not seen fresh material amongst the quite numerous samples examined from seashore debris until Mrs



M. J. Morgan collected some specimens from seaweed in the Menai Straits. Although Halbert (1920) and King (1914) also found specimens under decaying seaweed, I feel that Halbert's (1915, 1920) comments that it is found under stones and shingle allude most probably to the more usual habitat of this large species which in all probability is a widely distributed and common member of the seashore community. It is interesting to note that it was not recorded by Glynne-Williams & Hobart (1952) in their study of seashore crevice fauna on Anglesey.

*Vulgarogamasus kraepelini* (Berlese) comb. nov.  
(Figs 26A–M; 27A–G)

*Gamasus* (*Eugamasus*) *Kraepelini* Berlese, 1905: 232; 1906: 170.

*Gamasus kraepelini*: Hull, 1918: 85.

*Eugamasus kraepelini*: Schweizer, 1961: 21. Holzman, 1969: 8.

*Parasitus kraepelini*: Micherdzinski, 1969: 573. Karg, 1971: 450.

*Parasitus intermedius* (Berlese, 1882 *sic*) sensu Turk & Turk, 1952: 478, non Berlese, 1904a = *P. mustelarum* Oudemans, 1902b.

*Parasitus* (*Eugamasus*) *kraepelini*: Tichomirov, 1969: 1475. Bregetova *et al.*, 1977: 63, 69.

*Paracarpais* (*Aceocarpais*) *kraepelini*: Athias-Henriot, 1978: 48

I have examined Schweizer's types of both *Eugamasus zschokkei* (1922) and *Eugamasus zschokkei* var. *fturi* (1949), but unlike Micherdzinski (1969) I do not consider the latter to be synonymous with *kraepelini*. Both *zschokkei* and *fturi* are similar to *kraepelini*, but are not conspecific with any of the known British species.

**DEUTONYMPH.** The podonotal shield (370–450  $\mu\text{m}$  long  $\times$  440–470  $\mu\text{m}$  wide) is entirely reticulated and bears 20 pairs of fine slender setae (Fig. 26A). Setae *s*<sub>2</sub> are off the shield, and *z*<sub>5</sub> and *r*<sub>3</sub> are the longest and show fine traces of pilosity. In the specimen figured the right *s*<sub>6</sub> is off the shield. The opisthonotal shield (260–290  $\mu\text{m}$  long  $\times$  400–410  $\mu\text{m}$  wide) is entirely reticulated. It bears 13 pairs of fine simple setae which increase in length posteriorly. Some show fine pilosity. The setae on the posterior membrane are similar.

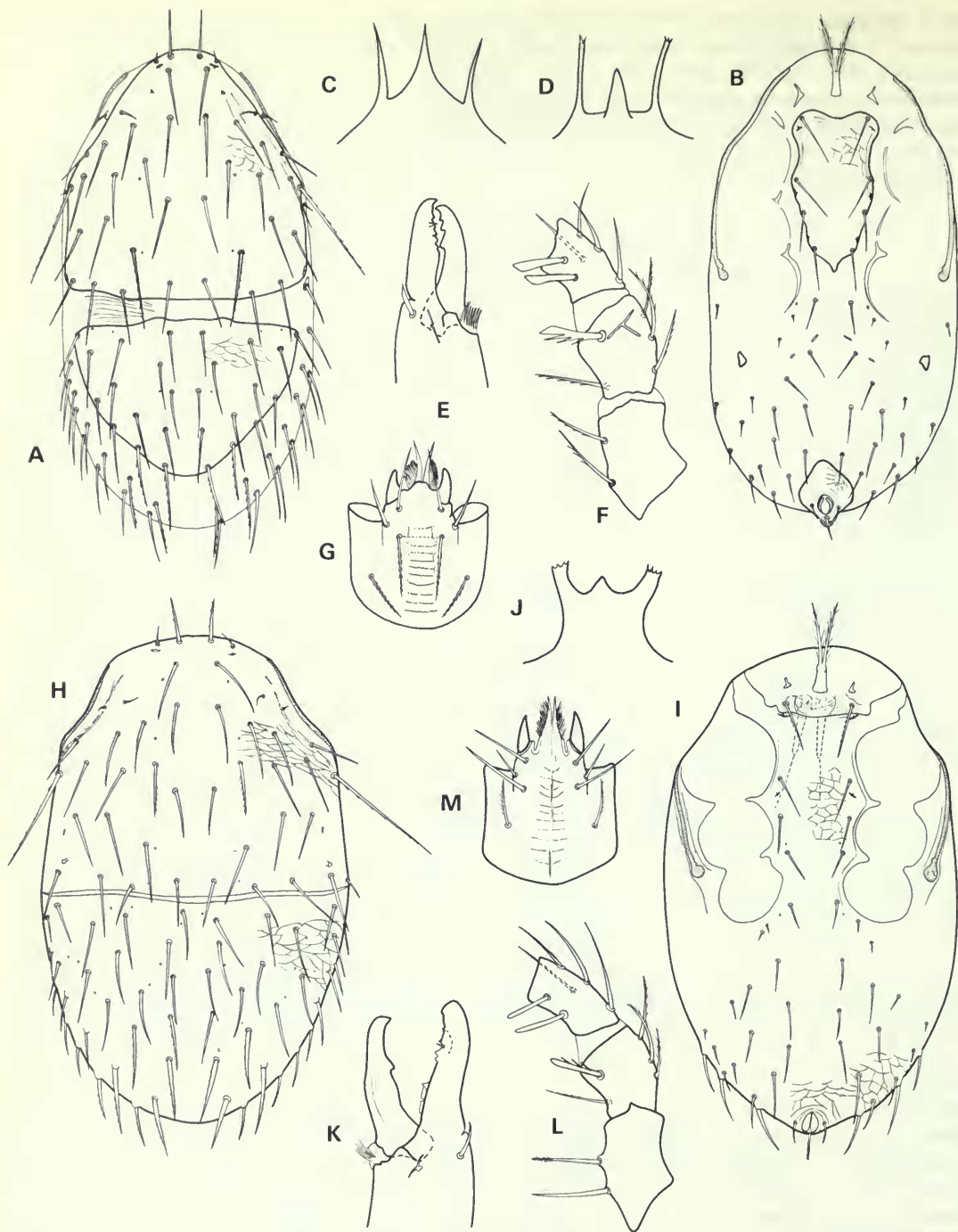
The tritosternum has a narrow base and pilose laciniae. It is flanked by small squarish or rectangular presternal shields. The sternal shield (260–290  $\mu\text{m}$  long) appears to be consistently rounded, concave anteriorly and with a regular outline (Fig. 26B). All sternal and opisthogastric setae are fine and slender. The anal shield is broadly oval and reticulated with the postanal seta twice the length of the paranals. The metapodal shields are generally present although indistinct, and the peritreme extends to coxa I.

The tectum comprises three prongs, generally of even length, with the outer two being the more slender, but the centre one may be short (Figs 26C, D). The chelicera is shown in figure 26E, the chaetotaxy of the palp trochanter, femur and genu in figure 26F, and the venter of the gnathosoma in figure 26G. The leg setae are slender and on legs II–IV many are finely pilose. Genu IV bears a strong curved pilose dorsal seta distally. The longest seta on tarsus IV measures *c.* 215  $\mu\text{m}$ .

**MALE.** The idiosoma is strongly sclerotized and measures 840–864  $\mu\text{m}$  long  $\times$  492–592  $\mu\text{m}$  wide. The dorsum is divided by a median transverse suture and the two halves may overlap (Fig. 26H). The podonotal region bears 21–22 pairs of setae which are mainly without traces of pilosity, although *j*<sub>1</sub>, *j*<sub>4</sub> and *r*<sub>3</sub> are generally finely pilose. A short seta external to *s*<sub>6</sub> is not always on the dorsal surface. The opisthonotal region bears no conspicuously long setae although some posteriorly are stouter than the majority and a number show fine pilosity.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of small right-angled to squarish presternal shields (Fig. 26I). Sternal setae I, which appear finely pilose, are situated off the sclerotized holoventral area on to a granular strip flanking the genital lamina. The postanal seta is one and a half times as long as the paranals, but considerably stouter and also finely pilose. The peritreme extends to coxa I.

The tectum is uniquely shaped and shows little variation (Fig. 26J). The chelicera is shown



**Fig. 26** *Vulgarogamasus kraepelini* (Berlese), **deutonymph** – A dorsum; B venter; C, D tectum; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma; **male** – H dorsum; I venter; J tectum; K chelicera; L palp trochanter, femur and genu; M venter of gnathosoma.

in figure 26K. The spermatophoral process is only apparent as an enlargement of the basal half of the movable digit. The fixed digit bears three small teeth and half a dozen very small denticles. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 26L,

and the venter of the gnathosoma in figure 26M. Leg I bears very fine setae. Leg II is as in figure 27A, the lower inner spur on the femur being sometimes pointed or irregular. Leg III bears stouter setae than leg I, whilst leg IV bears stouter setae again and on the tarsus an erect pilose seta c. 175  $\mu\text{m}$  long.

**FEMALE:** The podonotal shield (396–504  $\mu\text{m}$  long  $\times$  444–540  $\mu\text{m}$  wide) is entirely reticulated and bears 22 pairs of setae which are generally of even length and individually pass the bases of the next. Only *r*<sub>3</sub> are longer and stout and pilose (Fig. 27B). The opisthonotal shield (360–456  $\mu\text{m}$  long  $\times$  432–528  $\mu\text{m}$  wide) is also entirely reticulated. It bears 25 pairs of setae of which a number of the more posterior pairs are clearly pilose distally.

The tritosternum has a narrow base and pilose laciniae, and the presternal shields are very small. Sternal setae I are situated anterior to the sclerotized part of the sternal shield which is itself generally deeply indented posteriorly (Fig. 27C). This indentation can be irregular or even sealed off from the posterior margin. The genital shield is broad and pointed anteriorly and has a pair of lateral horns. All the ventral setae are fine and slender. The postanal seta is stouter and longer than the paranals. The peritreme extends to coxa I.

The tectum is as in figure 27D, the only variation noted being that the centre prong may be considerably shorter. The chelicera is shown in figure 27E, the palp trochanter, femur and genu in figure 27F, and the venter of the gnathosoma in figure 27G. The setae of leg I are long and fine, leg II bears considerably stouter setae, whilst on leg III they are mainly slender. Leg IV bears predominately stout long setae, a number of which are erect and often finely pilose.

**MATERIAL EXAMINED.** 61 samples – 24 DNN, 17 ♂♂, 80 ♀♀.

**ENGLAND:** Gloucestershire, Hampshire, Essex, Berkshire, Buckinghamshire, Nottinghamshire, Cheshire, Lancashire, Cumberland, Northumberland.

**WALES:** Monmouthshire, Merionethshire.

**SCOTLAND:** Roxburghshire, Midlothian, Argyllshire, Aberdeenshire, Perthshire, Angus, Ross and Cromarty, Inner Hebrides (Mull, Ulva), Shetland.

**IRELAND:** Dublin, Kildare, Westmeath.

Thirty-three of the samples examined are from Scotland. Habitats are wide ranging, viz. on small mammals and in their nests, an ants' nest, coniferous and deciduous litter, mosses, grassland, flood debris, rotten wood and on fungi.

**DISTRIBUTION:** Previous British records are those of Halbert (1915) who recorded the male from decayed fungi at Glendalough, Co. Wicklow, and a female as *Gamasus* (*Eugamasus*) *magnus* Kramer, which I have examined, from amongst moss in Knappagh Wood, Westport, Co. Mayo, August 1911. Hull (1918) recorded it from Northumberland, Ireland (presumably Halbert's record), and the Isle of May, Scotland, and Curry (1969) collected it in grassland in Co. Kildare. Turk & Turk's (1952) record of a female of *Parasitus intermedius* (Berlese) from Delamere, Cheshire, 22 March 1925, is referable to this species. Hull (1917) considers that *Parasitus vespillonum* Oudemans, 1902*b* is the deutonymph of *kraepelini*, but three deutonymphs of *vespillonum* (the only stage described) in the Oudemans Collection closely resemble small specimens of *Parasitus consanguineus* Oudemans & Voigts. As already pointed out by Micherdzinski (1969) the record of this species by Turk (1945) from Bagley Wood, Oxfordshire, is clearly an error of identification and the specimens are not available for comment.

This species is recorded from Iceland (Sellnick, 1940), Finland (Nordberg, 1936), Sweden (Trägårdh, 1910), Germany (Berlese, 1905, 1906, Schweizer, 1925, Willmann, 1939*b*, 1951*a*, Holzmann, 1969, Karg, 1965, 1971), Austria (Franz, 1943, Leitner, 1946, Willmann, 1951*b*), Switzerland (Schweizer, 1961), Czechoslovakia (Willmann, 1954, 1956, Mrciak & Rosicky, 1956, Halašková, 1959), Hungary (Willmann, 1938*a*), Poland (Pax & Maschke, 1935, Willmann, 1956, Micherdzinski, 1969) and the U.S.S.R. (Pinchuk, 1976) and Western Siberia (Davydova, 1969, 1976).



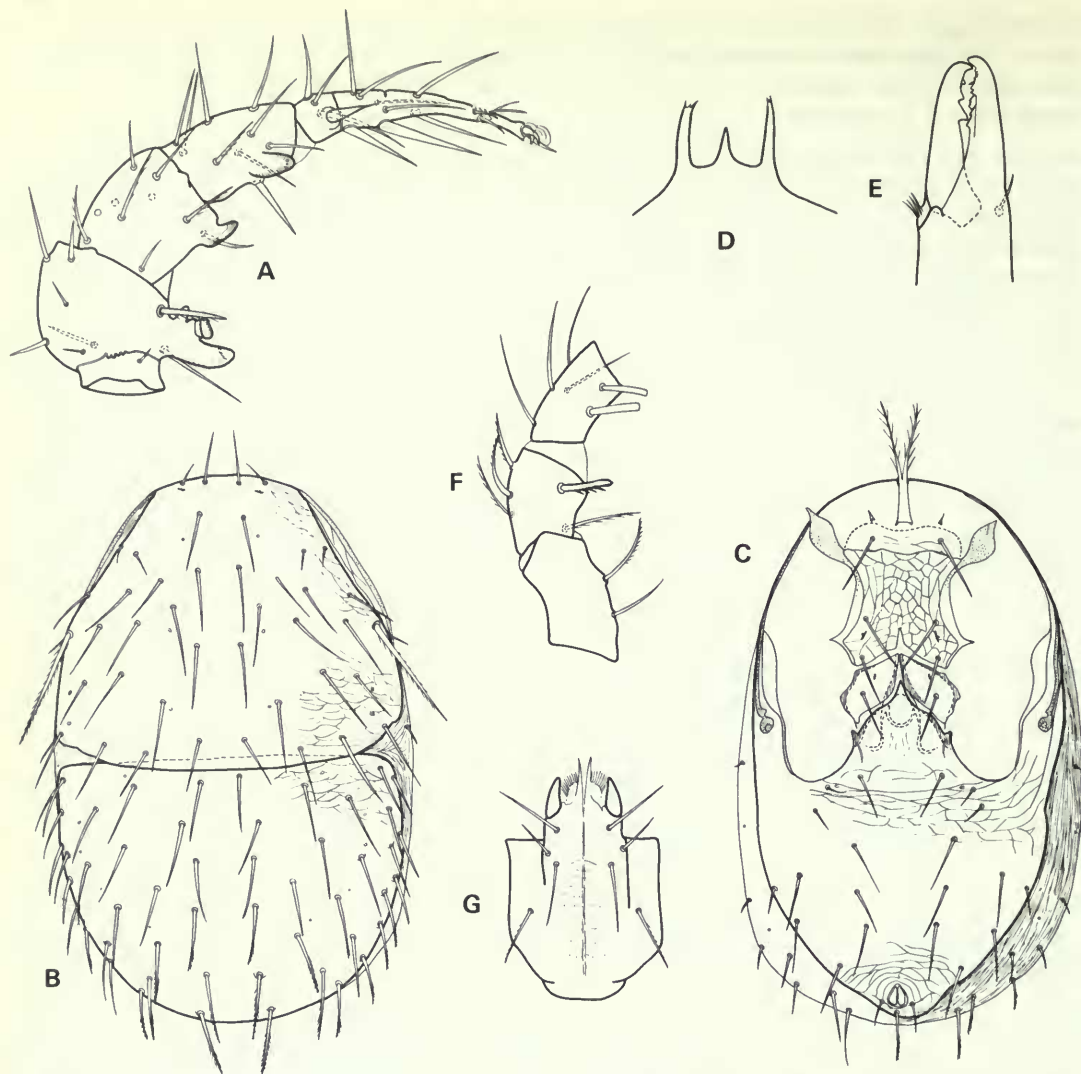


Fig. 27 *Vulgarogamasus kraepelini* (Berlese), male – A leg II; female – B dorsum; C venter; D tectum; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma.

*Vulgarogamasus oudemansi* (Berlese) comb. nov.  
(Figs 28A–N; 29A–F)

*Parasitus emarginatus* (C. L. Koch, 1839) sensu Oudemans, 1902b: 40.

*Gamasus* (*Eugamasus*) *oudemansi* Berlese, 1904b: 280; 1906: 167.

*Eugamasus oudemansi*: Willmann, 1936b: 195. Athias-Henriot, 1979: 7.

*Parasitus oudemansi*: Micherdzinski, 1969: 563. Holzmann, 1969: 16. Karg, 1971: 448.

*Parasitus* (*Eugamasus*) *oudemansi*: Tichomirov, 1969: 1475. Bregetova *et al.*, 1977: 63, 69.

Bregetova (1956) followed Oudemans (1914) in suggesting that the male of *oudemansi* may be a heteromorphic form of *magnus* although Willmann (1936b) had found males and females of *oudemansi* together and had figured the female which is distinct from that of *magnus*. Holzmann (1969) and Bregetova *et al.* (1977) treat *oudemansi* as a distinct species. In the present study the incidence of males and females occurring together, plus the fact that one of the deutonymphs was showing the developing male within, and the combinations of

chaetotactic and other external morphological differences which are apparent from the figures, leave no doubt that *oudemansi* is a distinct species.

**DEUTONYMPH.** The podonotal shield (470–490  $\mu\text{m}$  long  $\times$  460–530  $\mu\text{m}$  wide) is entirely reticulated and bears 20 pairs of setae, *s2* being off the shield (Fig. 28A). The shortest setae are *z1*, *s1*, *s2* and *r2* and the longest is *r3*, but the remainder are longer than average and most surpass the base of the next, with *z2* being slightly stouter. A number, especially *j1* and *r3*, are finely pilose to some degree. The opisthonotal shield (310–320  $\mu\text{m}$  long  $\times$  420–455  $\mu\text{m}$  wide) is also entirely reticulated and bears 13 pairs of longish setae similar to those of the podonotal shield. The setae on the posterior membrane arise from strong bases and are similar and may be slightly pilose at their tips.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of very small presternal shields (Fig. 28B). The sternal shield (310–320  $\mu\text{m}$  long) is entirely reticulated and of a rather conspicuous symmetrical outline, the anterior margin being strongly undulated and reminiscent of some *Pergamasus* deutonymphs. The sternal setae are slightly longer than the opisthogastric setae and may show some pilosity. The reticulated anal shield is attenuated anteriorly, whilst the postanal seta is slightly longer than the paranals. The peritreme extends to coxa I.

The trispinate tectum may have the slender lateral prongs finely bifid at their tips (Fig. 28C). The chelicera is shown in figure 28D, and the venter of the gnathosoma in figure 28E. The palpcoxal setae are finely pilose. The palp trochanter, femur and genu are as in figure 28F. The leg setae are basically simple, although some show small degrees of pilosity. The femur and tarsus of leg IV each bear dorsally a long fine seta measuring *c.* 200  $\mu\text{m}$  and *c.* 250  $\mu\text{m}$  respectively.

**MALE.** The dorsum is strongly sclerotized, entirely reticulated, and divided medially by a transverse suture. It measures 980–1140  $\mu\text{m}$  long  $\times$  564–650  $\mu\text{m}$  wide (Fig. 28G). The podonotal region bears 23 pairs of setae: *z1*, *s1*, *s2* and *r4* are the shortest, *r3* is the longest (*c.* 265  $\mu\text{m}$ ) and is very finely but sparsely pilose. The remaining setae are slender and some show traces of pilosity. The opisthonotal region bears about 25–27 pairs of strong setae similar to the majority on the podonotum.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of conspicuous triangular presternal shields (Fig. 28H). The holoventral shield is heavily sclerotized except for the narrow area in front of sternal pores I. The genital lamina protrudes from the anterior edge of the sternal shield. Sternal setae IV–V are shorter than I–III, but the opisthogastric setae are longer again and some are finely pilose. The paranal setae are only slightly shorter than the postanal. The peritreme extends to coxa I.

The typical tectum comprises a broad triangular plate, somewhat uneven in outline, with a pair of lateral teeth set well back (Fig. 28I). In some of the specimens it is lacking at least one of the teeth and is more uneven (Fig. 28J). The chelicera is shown in detail in figure 28K: the cluster of fine teeth adjacent to the *pilus dentilis* show considerable variation in their contour, due partly to their formation and partly to the angle of view. The chaetotaxy of the palp trochanter, femur and genu is as in figure 28L. In one specimen examined the stout proximal seta of the trochanter is of normal thickness on the right palp, but only half as thick on the left, and the corniculi have rounded, not pointed, tips. The venter of the gnathosoma is shown in figure 28M. The internal posterior hypostomatic setae are the longest, the palpcoxal setae are finely pilose, and the corniculi are strong and bold. Leg II is shown in detail in figure 28N. Some of the setae are finely pilose. The majority of setae on leg I are fine and slender, but a single short stout dorsal seta is present on both the trochanter and the femur. Leg III bears generally stouter setae than leg I, whilst on leg IV they are also stouter and some are sinuous.

**FEMALE.** The podonotal shield (516–564  $\mu\text{m}$  long  $\times$  526–600  $\mu\text{m}$  wide) is completely reticulated and bears 21 pairs of setae (Fig. 29A), but in the specimen figured there is no trace of the right *z5* although its associated pore is present. Setae *z1*, *s1*, *s2* and *r2* are considerably



**Fig. 28** *Vulgarogamasus oudemansi* (Berlese), **deutonymph** - A dorsum; B venter; C tectum; D chelicera; E venter of gnathosoma; F palp trochanter, femur and genu; **male** - G dorsum; H venter; I, J tectum; K chelicera; L. palp trochanter, femur and genu; M venter of gnathosoma and palp trochanters; N leg II.



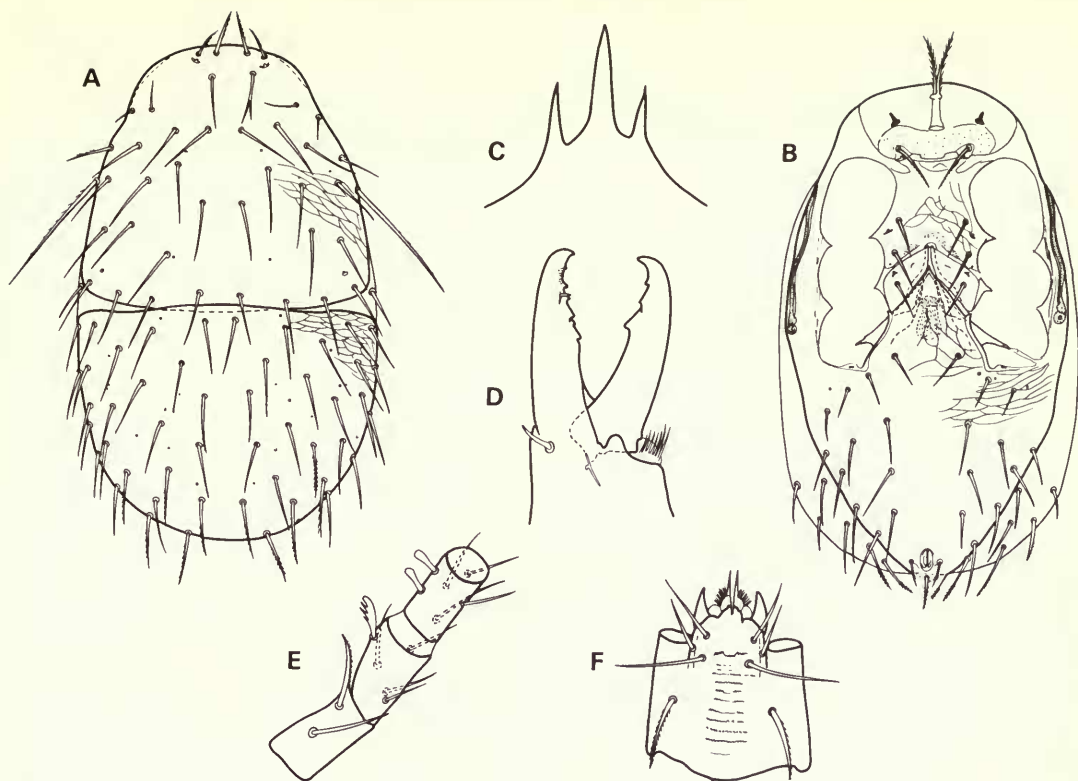


Fig. 29 *Vulgarogamasus oudemansi* (Berlese), female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

longer than in most other species; *s1* and *s2* are very fine; *r3* are *c.* 240  $\mu$ m in length and bear sparse traces of pilosity. The opisthonotal shield (480–516  $\mu$ m long  $\times$  540–660  $\mu$ m wide) is also entirely reticulated and bears 24 pairs of symmetrically arranged setae. Most reach or surpass the bases of the next and a few are pilose to some extent.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of rather granular presternal shields (Fig. 29B). The sternal shield is granular and concave distally. The sternal setae are slightly stouter than the metasternals and genitals. The genital shield is triangular and has a small pair of lateral horns midway. The ten or eleven pairs of opisthogastric setae are strong and simple. The postanal seta is pilose and the paranals simple. The peritreme extends to coxa I.

The tectum comprises a stout central prong and a pair of shorter slightly divergent lateral prongs (Fig. 29C). The chelicerae have a fine granular region between the distal teeth of the fixed digit (Fig. 29D). The chaetotaxy of the palp trochanter, femur and genu is shown in figure 29E, and the venter of the gnathosoma in figure 29F. As in the male, the internal posterior hypostomatic setae are the longest, the palpcoxal setae are finely pilose, and the corniculi are strong and bold. The setae on leg I are fine and slender. Leg II bears ventrally two conspicuous stout setae on the trochanter, one on the femur, two on the genu, two on the tibia and three on the tarsus. Leg III bears stout ventral setae on the genu, tibia and tarsus. Leg IV bears stout setae on the femur, genu and tarsus, those on the tarsus being the longest.

**MATERIAL EXAMINED.** 19 samples – 3 DNN, 36  $\sigma\sigma$ , 37  $\text{♀♀}$ .

ENGLAND: Somerset, Hampshire, Surrey, Essex, Buckinghamshire, Bedfordshire, Cambridgeshire, Cheshire, Durham.

SCOTLAND: Midlothian, Roxburghshire, Perthshire, Isle of Rhum.

IRELAND: Cork.

Most specimens were collected from the nests of small mammals and birds, including three females from the nest of Manx shearwater *Procellaria puffinus* Brünnich on the Isle of Rhum, Inner Hebrides.

**DISTRIBUTION.** The only previous record for the British Isles is that of Hull (1918) who recorded it from moles' nests in Northumberland.

It is recorded from Iceland (Sellnick, 1940), Sweden (Lundqvist, 1974), Holland (Oudemans, 1902*b*, 1912*a*, 1914) Germany (Oudemans, 1903*a*, Holzmann, 1969, Karg, 1971), Austria (Franz, 1943, Willmann, 1951*a*), Poland (Kielczewski, 1957, Zukowski, 1958), Czechoslovakia (Willmann, 1936*b*, Maschke, 1936) and Western Siberia (Davydova, 1969, 1976).

*Vulgarogamasus remberti* (Oudemans)  
(Figs 30A–G; 31A–L)

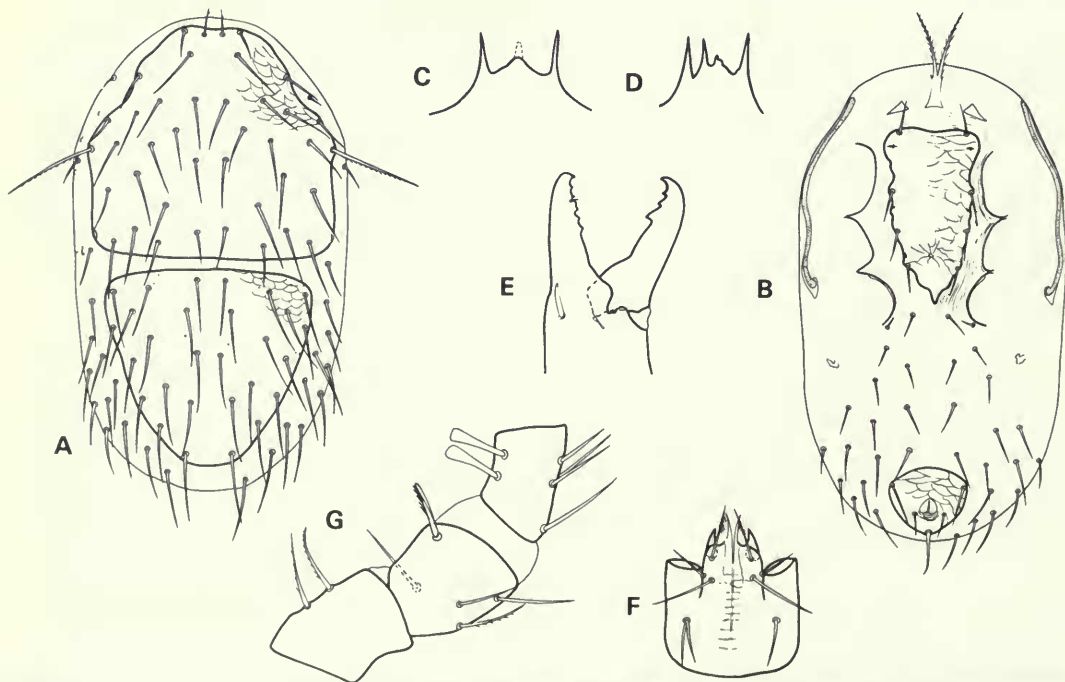
*Eugamasus remberti* Oudemans, 1912*b*: 243; 1912*d*: Verslag LI; 1914: 131. Holzmann, 1969: 17.

*Parasitus remberti*: Micherdzinski, 1969: 588. Karg, 1971: 447.

*Parasitus (Vulgarogamasus) remberti*: Tichomirov, 1969: 1336, 1476. Bregetova *et al.*, 1977: 81, 83.

**DEUTONYMPH.** The podonotal shield (277–300  $\mu\text{m}$  long  $\times$  300–324  $\mu\text{m}$  wide) is reticulated and bears 20 pairs of fine slender setae (Fig. 30A), of which *s*<sub>2</sub> are situated off the shield and *r*<sub>3</sub> are the longest (c. 125  $\mu\text{m}$ ). Setae *z*<sub>5</sub> are only slightly longer than adjacent setae. The opisthonotal shield (228–252  $\mu\text{m}$  long  $\times$  276–312  $\mu\text{m}$  wide) is also reticulated. It bears 14 pairs of slender simple setae of almost equal length and the surrounding posterior membrane bears similar setae.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of lightly sclerotized presternal shields (Fig. 30B). The sternal shield (c. 215  $\mu\text{m}$  long) is reticulated, the setae are slender and simple, as are the fifteen or so pairs of opisthogastric setae. The reticulated anal shield is widened anteriorly and invariably bears one pair of preanal setae at



**Fig. 30** *Vulgarogamasus remberti* (Oudemans), deutonymph – A dorsum; B venter; C, D tectum; E chelicera; F venter of gnathosoma; G palp trochanter, femur and genu.

its outermost anterior angles. The paranal setae are approximately half the length of the stouter postanal seta. The peritreme extends to coxa I.

The tectum is essentially trispinate (Fig. 30C), but irregularities occur (Fig. 30D). The movable digit of the chelicera bears three well-defined teeth, but on the fixed digit the teeth are small and less regular (Fig. 30E). The venter of the gnathosoma is shown in figure 30F: the internal posterior hypostomatic setae are the longest and, in the specimen figured, one of the palpcoxal setae is forked from its base. The corniculi are small. The palp trochanter, femur and genu are shown in figure 30G. The leg setae are simple and mainly fine and slender, whilst on leg IV, and in particular on the tarsus, several larger curved setae are present.

**MALE.** The dorsum (468–528  $\mu\text{m}$  long  $\times$  216–276  $\mu\text{m}$  wide) is entirely reticulated and is divided medially by a transverse suture (Fig. 31A). The podonotal region bears 23 pairs of simple slender setae of which *r5* are the longest (*c.* 80  $\mu\text{m}$ ), *s2* are very short, and *r4* are clearly visible behind *r3*. The opisthonotal region bears about 30 pairs of similar setae arranged symmetrically.

The tritosternum has a short narrow base and pilose laciniae. The presternal shields are small and barely discernible (Fig. 31B). The holovertral shield is reticulated but generally weakly sclerotized. All the setae are simple. The genital aperture protrudes anterior to sternal setae I. The postanal seta is more than twice the length of the paranals. The peritreme extends to coxa I.

The tectum comprises three prongs, the central one may be rudimentary and irregular, but the laterals are always well developed (Fig. 31C). The chelicera is shown in detail in figure 31D. The movable digit (*c.* 45  $\mu\text{m}$ ) bears a single tooth and the fixed digit, which is slightly clubbed distally, a row of up to six very small teeth. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 31E, and the venter of the gnathosoma in figure 31F. The corniculi are small. Leg II is shown in detail in figure 31G: no variation in the formation of the spurs has been noted. The setae on leg I are fine and slender and those on legs III and IV somewhat stouter and longer.

**FEMALE.** The podonotal shield (*c.* 300  $\mu\text{m}$  long  $\times$  380  $\mu\text{m}$  wide when flattened) is rather weakly sclerotized and only partly reticulated (Fig. 31H). It bears 21 pairs of setae of which *s2* may be on or off the shield. Setae *r3* are the longest (*c.* 105  $\mu\text{m}$ ) and *z5* are slightly longer and stouter than adjacent setae. The opisthonotal shield (*c.* 330  $\mu\text{m}$  long  $\times$  380  $\mu\text{m}$  wide when flattened) is also weakly sclerotized and bears 25 or more pairs of simple setae in the specimen figured. In other specimens this shield appears not to extend ventrally, so consequently the number of setae on the sclerotized area is reduced. These specimens differ also from the figured specimen in that the opisthonotal setae are considerably shorter, shorter in fact than those figured by Holzmann (1969), and podonotal setae *j4* and *z5* are slightly stouter than those adjacent to them, a feature not shown by Holzmann, but shown by Oudemans (1914). I can, however, see no differences in the ventral sclerotization and chaetotaxy of these specimens or in the other features described and figured. Clearly more material needs to be examined.

The tritosternum has a narrow base and pilose laciniae, but there is only the slightest trace of presternal shields (Fig. 31I). Anteriorly the sternal shield is weakly sclerotized, but it becomes more clearly defined posteriorly from sternal setae II. All ventral setae are strong and simple. The genital shield is almost triangular in its anterior two thirds and it terminates in a narrow tip. The opisthogastric shield is undulating in outline but is fairly symmetrical. The postanal seta is of similar stoutness to the ventral setae, but the paranals are thinner and a little shorter. The peritreme extends to coxa I.

The tectum (Fig. 31J) is basically as in the male and deutonymph, with similar variation in the centre prong. The chelicera is shown in figure 31K. The chaetotaxy of the pedipalp is as in the male (Fig. 31E), and the venter of the gnathosoma is shown in figure 31L. The leg setae are basically simple and are most slender on leg I.



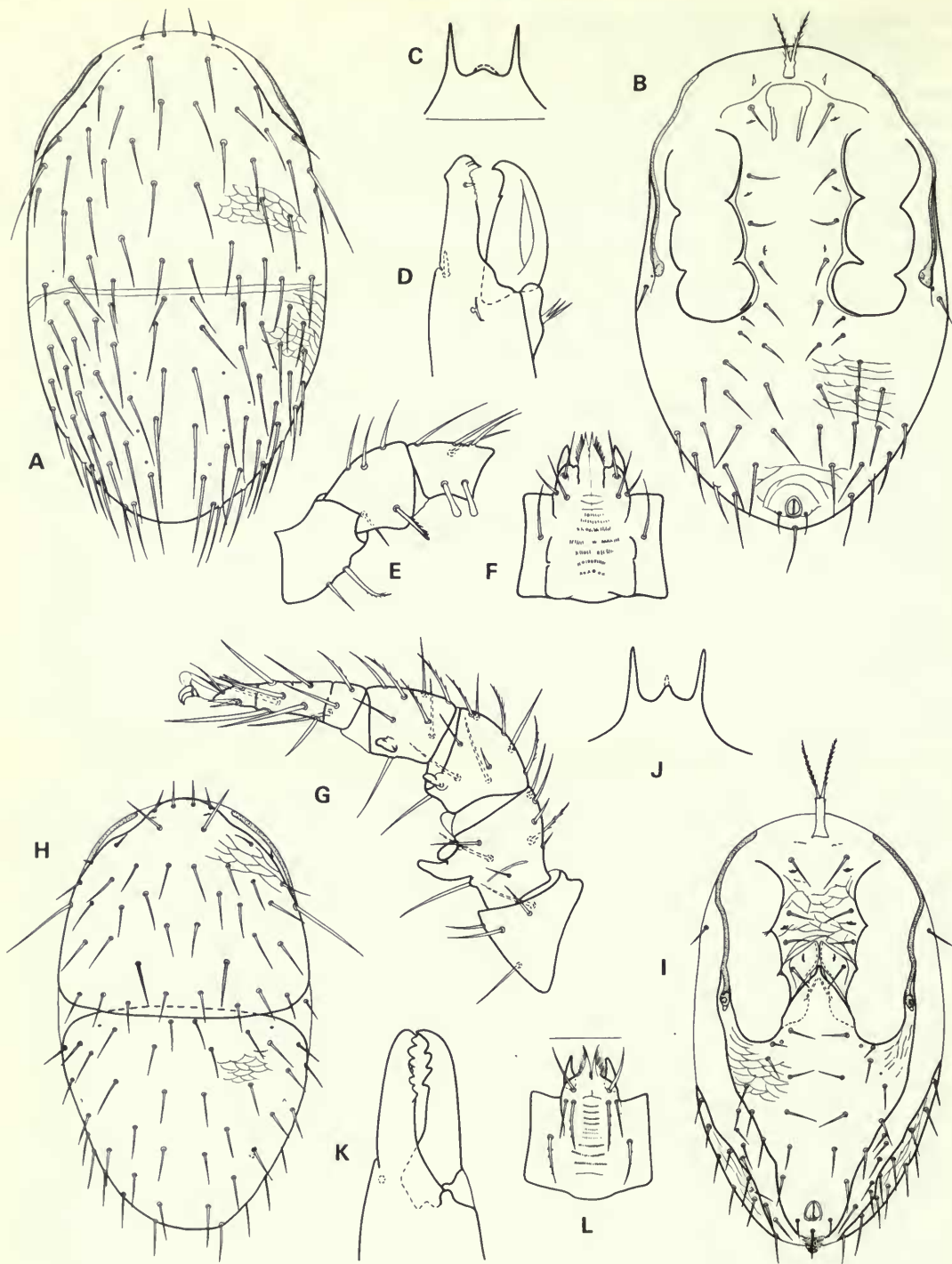


Fig. 31 *Vulgarogamasus remberti* (Oudemans), male—A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G leg II; female—H dorsum; I venter; J tectum; K chelicera; L venter of gnathosoma.

MATERIAL EXAMINED. 13 samples – 1 PN, 29 DNN, 9 ♂♂, 6 ♀♀.

ENGLAND: Gloucestershire, Wiltshire, London, Cambridgeshire.

SCOTLAND: Roxburghshire, Midlothian, West Lothian, Angus, Argyllshire (Lismore), Inverness-shire (Rhum).

Most specimens were collected from nests of the mole *Talpa europaea* L., but others are from *Sorex*, *Apodemus* and *Microtus*, and also the drey of grey squirrel *Sciurus carolinensis* Gmelin and old nests of blackbird *Turdus merula* L., tawny owl *Strix aluco* L. and Manx shearwater *Procellaria puffinus* Brünnich.

DISTRIBUTION. The only previous British record of this species is that of Mead-Briggs and Hughes (1966) who examined specimens from rabbits *Oryctolagus cuniculus* (L.) in Fifeshire.

It is recorded from Iceland (Sellnick, 1940), Sweden (Lundqvist, 1974), Finland (Nordberg, 1936), Holland (Oudemans, 1912*d*, 1914), Belgium (van Daele & Heungens, 1974), Germany (Willmann, 1938*b*, 1952*b*, Karg, 1965, 1971, Holzmann, 1969), Austria (Willmann, 1951*b*), Czechoslovakia (Willmann, 1952), Poland (Willmann, 1952*b*), the U.S.S.R. (Pirjanik, 1962, Bregetova, 1956, Pinchuk, 1976) and Western Siberia (Davydova, 1969, 1976). Most records are of specimens associated with small mammals, especially mice and voles.

*Vulgarogamasus trouessarti* (Berlese)

(Figs 32A–N; 33A–F)

*Gamasus thalassinus* Berlese & Trouessart, 1889; [121–143] (not seen), non Grube, 1861, teste Berlese, 1892*a*: 67.

*Gamasus Trouessarti* Berlese, 1892*a*: 67 (non 1902 auctt. including Micherdzinski, 1969 and Karg, 1971).

*Gamasus (Eugamasus) Trouessarti*: Berlese, 1906: 182.

*Eugamasus trouessarti*: Holzmann, 1969: 16.

*Parasitus trouessarti*: Micherdzinski, 1969: 512. Karg, 1971: 447.

*Parasitus (Vulgarogamasus) trouessarti*: Tichomirov, 1969: 1336, 1476. Bregetova *et al.*, 1977: 80, 81.

*Gamasus (Eugamasus) excurrens* Berlese, 1904*b*: 263; 1906: 165, 166.

DEUTONYMPH. The two deutonymphs examined are both weakly sclerotized. The podonotal shield (520–540  $\mu\text{m}$  long  $\times$  510–530  $\mu\text{m}$  wide) is reticulated and bears 22 pairs of simple setae, *r5* are the longest, the remainder of almost equal length (Fig. 32A). Setae *jl* are unusually well separated and *s2* and *r2* are off the shield. The reticulated opisthonotal shield is small (380–390  $\mu\text{m}$  long  $\times$  370–390  $\mu\text{m}$  wide) and bears 14 pairs of setae of approximately equal length, the setae on the posterior membrane are similar.

The tritosternum has a narrow base and pilose laciniae. The presternal shields are weakly sclerotized. The sternal shield (Fig. 32B) is 395–405  $\mu\text{m}$  long and is lightly reticulated. The sternal and opisthogastric setae are simple. The anal shield bears four preanal setae on one specimen (Fig. 32B) and five on the other (Fig. 32C). The paranal setae are fine, the postanal longer and stout. The peritreme is slender and does not reach coxa I.

The tectum is multidenticulate with a median and two lateral cusps (Fig. 32D). The chelicera is shown in figure 32E, and the chaetotaxy of the palp trochanter, femur and genu in figure 32F. The gnathosomal setae are simple and the corniculi are strong (Fig. 32G). The majority of the leg setae are quite fine and slender, but stout sinuous setae are present mainly on legs III and IV.

MALE. The idiosoma is entirely sclerotized and reticulated, but dorsally the podonotal and opisthonotal regions are separated by a broad unsclerotized strip which extends the whole width of the idiosoma (Fig. 32H). The podonotal region (552–580  $\mu\text{m}$  long  $\times$  540–552  $\mu\text{m}$  wide) bears 25 pairs of setae of which a few appear to be finely pilose on one margin at least. The verticals, *jl*, are well separated, *r3* are the longest (*c.* 160  $\mu\text{m}$ ), and the remainder are all roughly equal in length (*c.* 100  $\mu\text{m}$ ). The opisthonotal region (480–504  $\mu\text{m}$  long  $\times$  504  $\mu\text{m}$  wide) bears about 31 pairs of symmetrically arranged setae of even length.

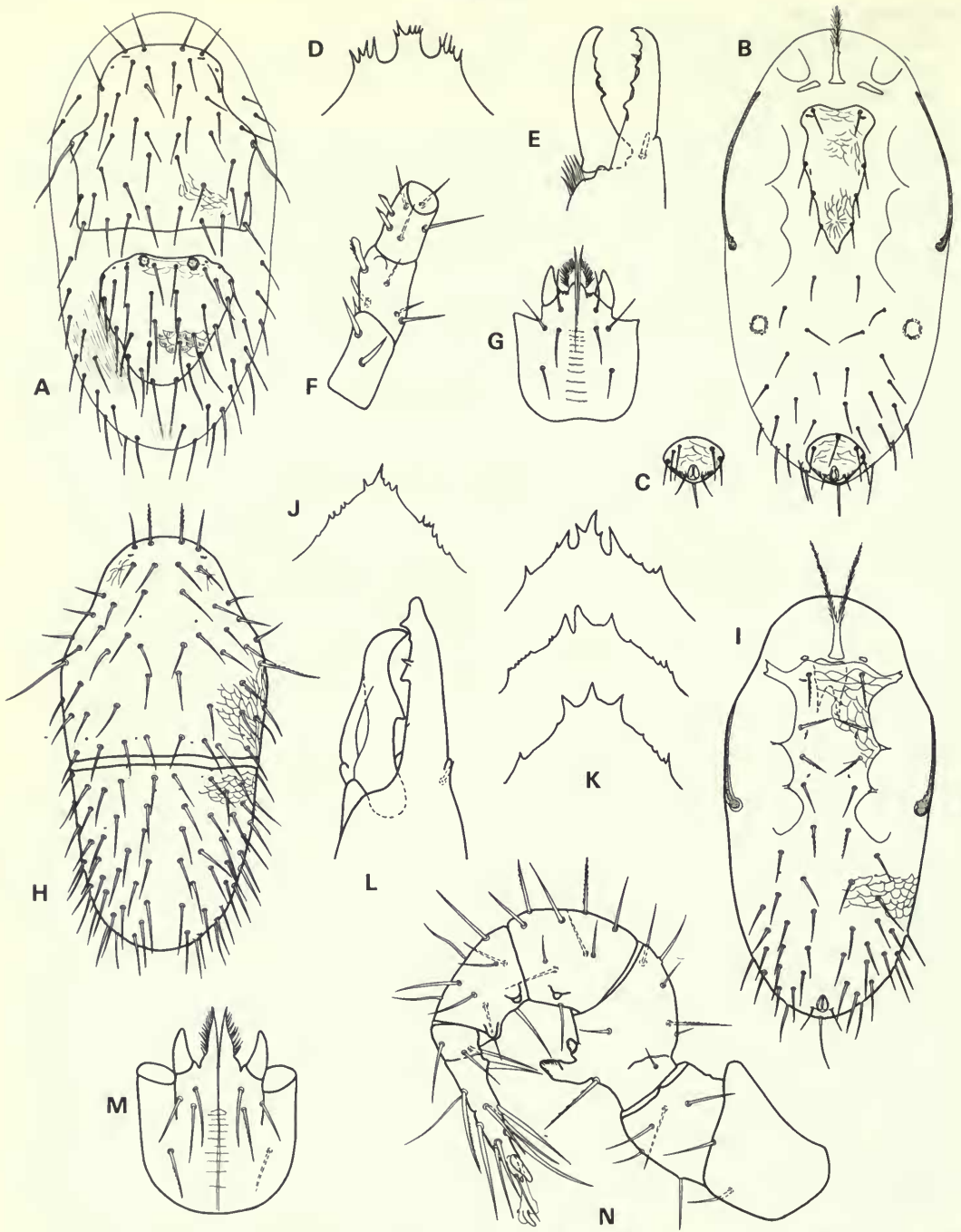


Fig. 32 *Vulgarogamasus trouessarti* (Berlese), deutonymph - A dorsum; B venter; C anal shield; D tectum; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma; male - H dorsum; I venter; J, K tectum, showing variation; L chelicera; M venter of gnathosoma; N leg II.

The tritosternum has a narrow base and long pilose laciniae. The presternal shields are small or even lacking (Fig. 32I). The venter is well sclerotized and reticulated. Some of the



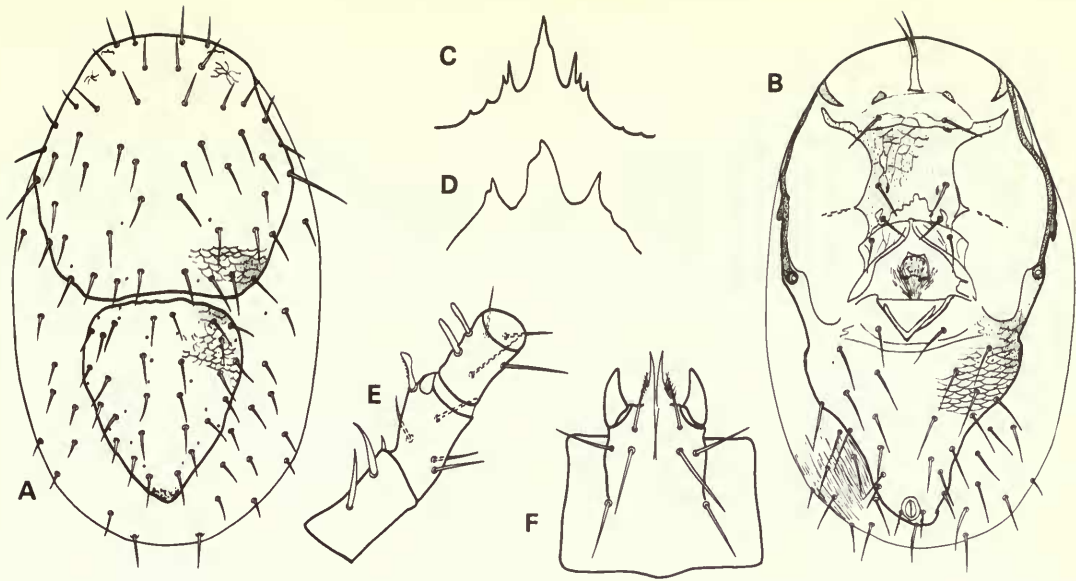


Fig. 33 *Vulgarogamasus trouessarti* (Berlese), female – A dorsum; B venter; C, D tectum, showing variation; E palp trochanter, femur and genu; F venter of gnathosoma.

ventral setae show traces of pilosity. The paranal setae are fine, the postanal stouter and twice as long. The peritreme extends just to coxa I.

The tectum comprises an irregularly toothed prominence. A fairly symmetrical example is shown in figure 32J, whilst variations from three specimens collected together are shown in figure 32K. The chelicera is shown in figure 32L. The chaetotaxy of the pedipalp is as in the female (Fig. 33E), and in both sexes a broad conical spur on the femur lies adjacent to the anterolateral seta. The venter of the gnathosoma is shown in figure 32M: the corniculi are stout and in the specimen figured, there is no trace of one of the palpcoxal setae. Leg II is shown in detail in figure 32N. The distal protuberance on the tibia is inconspicuous, but is shown in heavy outline for emphasis. The majority of the setae on the other legs are fine and simple, but on leg IV longer and stouter setae are apparent.

**FEMALE.** The dorsal shields are well sclerotized, reticulated, granular and are of conspicuous outline (Fig. 33A). The podonotal tapers from its midpoint and the opisthonotal, which is pear shaped, continues the effect of this taper. The podonotal shield (600–630  $\mu\text{m}$  long  $\times$  528–570  $\mu\text{m}$  wide) bears 24 pairs of setae. The verticals, *j1*, are well separated as in the deutonymph. Setae *r3* are the longest (*c.* 105  $\mu\text{m}$ ), but others approach this length. The opisthonotal shield (423–460  $\mu\text{m}$  long  $\times$  360–408  $\mu\text{m}$  wide) bears generally 14 pairs of setae, but in the specimen figured one seta is missing from the right side, whilst in others 15 setae are present on one side, or they may be evenly paired.

The tritosternum has a narrow base and pilose laciniae. The presternal shields are triangular and granular (Fig. 33B). Basically the ventral shields are all granular and well sclerotized, but the sternal is weak and transparent anterior to pore I and also along its irregular posterior margin. The genital shield is broad and triangular, but in the specimen figured it is folded back. The opisthogastric shield is frequently of asymmetrical outline. The anal setae are partly pilose and are slender, the postanal being the longest. All other ventral setae are slender and simple. The peritreme extends just to coxa I.

A well-formed tectum is shown in figure 33C. It has the central portion in the form of a single broad tooth and the two flanking cusps are toothed, but not as prominently as in the deutonymph, whilst further back are short spines variously developed. A less regularly formed specimen is shown in figure 33D. The chelicerae are as in the deutonymph (Fig. 32E). The chaetotaxy of the pedipalp is shown in figure 33E: the femur bears a distal broad

conical tooth adjacent to the anterolateral seta. The venter of the gnathosoma is shown in figure 33F: the corniculi are strong. Leg I bears very fine setae, and on legs II–IV the setae become progressively stouter whilst retaining their fineness.

MATERIAL EXAMINED. 7 samples – 2 DNN, 10 ♂♂, 10 ♀♀.

ENGLAND: Devon, Hampshire, Durham.

WALES: Anglesey.

SCOTLAND: Aberdeenshire.

This exclusively seashore species is, despite the scarcity of records, probably found throughout the British Isles, but its frequency parallels that of *Vulgarogamasus immanis* (p. 292) and not *Parasitus kempersi* (p. 280). Halbert (1915, 1920), however, considered *trouessarti* to be abundant.

DISTRIBUTION. Previous British records are from Co. Mayo and Co. Dublin (Halbert, 1915, 1920), Northumberland and Lancashire (Hull, 1918), and Devon (Evans & Browning, 1954).

It is recorded from France and Norway (Berlese, 1904b, 1906) and Germany (Willmann, 1952a, Holzmann, 1969, Karg, 1971).

#### Genus *EUGAMASUS* Berlese

*Eugamasus* Berlese, 1892. *Acari, Myriopoda et Scorpiones hucusque in Italia reperta. Ordo Mesostigmata (Gamasidae)*. Padova: 62.

TYPE SPECIES. *Gamasus magnus* Kramer, 1876.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields. Setae of dorsal hexagon similar, varying only in length. Tritosternum normal, biramous, that of male not closely associated with genital orifice. Junction between sternal and metasternal shields of female oblique. Genital shield of female triangular or subtriangular. Opisthogaster with not more than 30 pairs of setae. Seta *al* of palp femur strongly multifid; setae *al*<sub>1</sub> and *al*<sub>2</sub> of palp genu bifid. Male chelicerae symmetrical. Corniculi short, entire. With the possible exception of coxa I, legs of deutonymph and female without spurs; only leg II of male spurred. Lobes of pulvilli rounded, normal.

#### *Eugamasus magnus* (Kramer) (Fig. 34A–I)

*Gamasus magnus* Kramer, 1876: 91. Berlese, 1884, Fasc. 13: Nos 5, 6. Non Berlese, 1906: 177 = *E. berlesei* Willmann, 1935.

*Parasitus magnus*: Micherdzinski, 1969: 497. Karg, 1971: 449 (♂ only).

*Parasitus (Eugamasus) magnus*: Tichomirov, 1969: 1475. Bregetova *et al.*, 1977: 67, 71.

*Eugamasus magnus*: Holzmann, 1969: 15 (♂ only). Athias-Henriot, 1979: 5. Evans & Till, 1979: 209.

*Eugamasus spinosustarsis* Schweizer, 1961: 23. **Syn. nov.** Type examined.

*Parasitus spinosustarsis*: Micherdzinski, 1969: 503.

I have examined Schweizer's (1961) material of *spinosustarsis* and consider that the males are synonymous with *Parasitus magnus* (Kramer) as figured by Berlese (1884) and Micherdzinski (1969). Schweizer's single deutonymph is *P. coleopratorum* and not *niveus* (= *loricatus*) as suggested by Micherdzinski (1969).

I am not prepared at present to state that *magnus* is in fact a distinct species from *berlesei*. Micherdzinski's treatment does not appear conclusive, whilst Holzmann's (1969) and Karg's (1971) keys to females leave one in doubt. One especially rich sample from a mole *Talpa europaea* L. nest examined in the present study contained seven species of Parasitinae including one male, twenty females and one deutonymph of *berlesei* and a single male of *magnus*, whilst, with one exception, the remaining samples from which male *magnus* were removed contained no *berlesei*. The exception is a slide already in the Museum collection (in cave, Sidcot Swallet, Somerset, July 1938) on which is mounted a typical male *magnus*

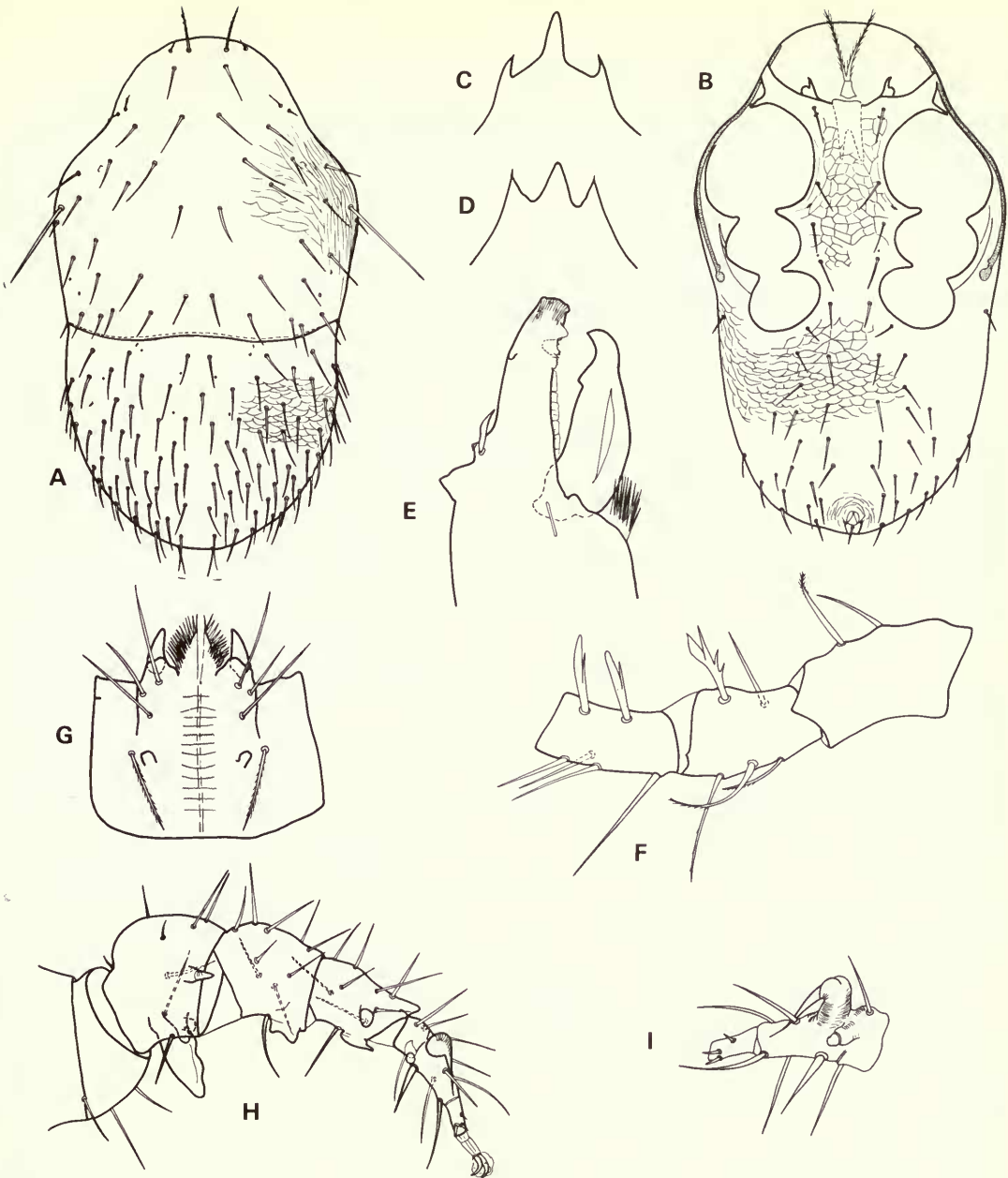


Fig. 34 *Eugamasus magnus* (Kramer), male – A dorsum; B venter; C tectum (typical); D tectum (irregular); E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma; H leg II; I tarsus of leg II excluding the ambulatorium.

(1580  $\mu\text{m}$  long) and a typical female *berlesei* (1280  $\mu\text{m}$  long), presumably the only specimens collected.

Excluding a single specimen from Rydal Water, Westmorland, the males referred to here as *magnus* are considerably larger than those of *berlesei* and are readily distinguished on the armature of leg II.



DEUTONYMPH. Not examined.

MALE. The dorsum (1356–1620  $\mu\text{m}$  long  $\times$  840–876  $\mu\text{m}$  wide) is completely sclerotized and generally reticulated, although in the podonotal region the reticulations are less marked. A transverse suture extends across the centre of the dorsum (Fig. 34A). The podonotal region bears 24 pairs of setae of which only *r*3 are long. The remainder are fine and simple, although *j*1 show traces of pilosity. The opisthonotal region bears approximately 45–50 pairs of simple setae which are arranged for the most part symmetrically.

The tritosternum has a short base and long pilose laciniae. It is flanked by a pair of characteristically shaped presternal shields. The rest of the ventral surface is strongly sclerotized and evenly reticulated (Fig. 34B). All the setae are fine and slender. The genital lamina is not markedly prominent. The peritreme extends to the level of coxa I. The anus is small and the postanal seta is longer than the paranals.

The tectum is typically a broad central prong, rounded at its tip and flanked by a pair of inwardly directed short pointed prongs (Fig. 34C). In one specimen, described below, the tectum is as in figure 34D. The chelicera, shown in figure 34E, is heavily sclerotized. The movable digit is 150  $\mu\text{m}$  long, rounded distally and bears one large tooth. The fixed digit is broad at its base with a large tooth-like protuberance and distal to this, a smaller one on the side of which is situated the dorsal seta. The inner edge of the digit bears a strip of fragmented membrane followed by a denticulate ridge adjacent to the *pilus dentilis*, a deep depression and an irregular large tooth. The tip of the fixed digit is broad. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 34F. The venter of the gnathosoma is as in figure 34G. The palpcoxal setae are finely pilose and inwards from their bases arises a pair of small rounded protuberances. Coxa I bears a small but pronounced apical tooth dorsally. Leg II is shown in figure 34H, the most conspicuous feature being the strong apically directed spine on the dorsal margin of the tarsus (Fig. 34I). Leg I (c. 1860  $\mu\text{m}$ ) has all setae fine and slender, leg III (c. 1150  $\mu\text{m}$ ) bears ventrally on the genu two stout setae and on the tibia one, the remaining setae being simple, and leg IV (c. 1750  $\mu\text{m}$ ) has no exceptionally stout setae, but there is a small dorsal protuberance on the trochanter.

A single male from lakeside debris, Rydal Water, Westmorland, 29 November 1954, M. E. Bacchus coll., has the idiosoma 1100  $\mu\text{m}$  long. The chaetotaxy is typical, but differs from the above description as follows: the tectum is as in figure 34D; the venter of the gnathosoma lacks the small protuberances; both legs II lack the small conical spur on the femur whilst the spur on the genu is considerably longer, one tibia has only one protuberance whilst the other has two, and one tarsus has the typical angular and pointed dorsal spur, but also a broad deep excrescence on the opposite side whereas the other tarsus has, in an almost ventral position, an angular spur with the point missing, but on the dorsal surface is a large conical spur. This specimen is clearly aberrant and although its size would place it in *berlesei*, the armature of leg II is predominantly *magnus*.

FEMALE. Not examined.

MATERIAL EXAMINED. 8 samples – 9  $\sigma\sigma$ .

ENGLAND: In Read's Cavern, Burrington, Somerset, 15 May 1940; in cave, Sidcot Swallet, Somerset, July 1938; in leaf litter (mainly oak), Robinswood Hill, Gloucester, 13 September 1959; in leaf litter, Earlswood, Warwickshire, 15 May 1962; in Hopping Piper Mine, Matlock Bath, Derbyshire, 18 May 1958; debris from middle zone, Rydal Water, Westmorland, 29 November 1954; in Ingleborough Cave, Clapham, Yorkshire, 21 November 1976.

SCOTLAND: In mole's nest, Midlothian/Roxburghshire borders, 1964.

DISTRIBUTION. Previous British records of *Eugamasus magnus* are most probably referable to *E. berlesei* Willmann (*q. v.*). It has not been possible to examine with certainty any of the material of Hull (1918) which was identified as *magnus*. Halbert's (1915) record from Knappagh Wood, Westport, Co. Mayo is referable to *Vulgarogamasus kraepelini* (*q. v.*). A single specimen (on a slide), from a dead bank-vole *Clethrionomys glareolus* (Schreber) from

Bagley Wood, Berkshire, identified by Vitzthum as *Eugamasus magnus* Kramer (Elton *et al.*, 1931), is a female deutonymph of *Parasitus loricatus*, therefore it is probably safe to say that *Eugamasus magnus* (Kramer) is now authentically recorded from the British Isles for the first time.

*Eugamasus magnus* is recorded (largely *teste* Micherdzinski, 1969) from Holland (Oudemans, 1914, 1913c, 1916), Belgium (Willmann, 1935, Leruth, 1939, van Daele & Heungens, 1974, 1975), France (Leruth, 1939), Germany (Kramer, 1876, Willmann, 1937, Holzmann, 1969, Karg, 1971), Austria (Leitner, 1946, Willmann, 1951b), Poland (Sellnick, 1940: 45, Kozlovski, 1955, Kielczewski, 1957, Micherdzinski, 1969), Hungary (Willmann, 1954), Czechoslovakia (Willmann, 1954, Mrciak & Rosický, 1956), Switzerland (Cooreman, 1959, Schweizer, 1961), Italy (Berlese, 1884), Yugoslavia (Willmann, 1941) and Finland (Willmann, 1938c). Davydova (1969) records *magnus* from Western Siberia but it is not clear whether *magnus* or *berlesei* are involved. In her second paper Davydova (1976) clearly figures both *magnus* and *berlesei*, again from Western Siberia.

***Eugamasus berlesei* Willmann**  
(Figs 35A–M; 36A–H)

*Eugamasus magnus* forma *berlesei* Willmann, 1935: 6.

*Parasitus berlesei*: Micherdzinski, 1969: 504. Karg, 1971: 449.

*Parasitus (Eugamasus) berlesei*: Bregetova *et al.*, 1977: 67, 71.

*Eugamasus berlesei*: Athias-Henriot, 1979: 7.

*Gamasus (Eugamasus) magnus* Kramer sensu Berlese, 1906: 177. Halbert, 1915: 50.

*Eugamasus magnus* (Kramer) sensu Schweizer, 1961: 22, and auctt.

*Eugamasus magnus* var. *monticola* Berlese sensu Schweizer, 1961: 26 (♀).

*Gamasus magnus* Kramer sensu Hull, 1918: 84.

*Eugamasus anglocavernarum* Turk, 1944: 150. Micherdzinski, 1969: 504. Type examined.

See also comments under *E. magnus*, p. 310.

**DEUTONYMPH.** The podonotal shield (456–580  $\mu\text{m}$  long  $\times$  430–580  $\mu\text{m}$  wide) is finely reticulated and bears 21–22 pairs of setae, *s2* being off the shield (Fig. 35A). The posterior margin of the shield in the specimen figured has five setae on the right and four on the left. Only setae *j1* and *r3* show fine traces of pilosity. Seta *z5* is only slightly longer than adjacent setae, *r3* is the only pair that is conspicuously long. The opisthonotal shield (340–380  $\mu\text{m}$  long  $\times$  420–456  $\mu\text{m}$  wide) is also finely reticulated. It bears 22 pairs of simple homogeneous setae, but in the specimen figured an extra unpaired seta is located posterior to *J1*. The interscutal membrane bears similar simple setae.

The tritosternum has a narrow base and pilose laciniae. The presternal shields are small. The reticulated sternal shield (324–370  $\mu\text{m}$  long) is acuminate posteriorly and the setae slender and simple (Fig. 35B). The broadly oval anal shield is reticulated and bears an extra pair of setae (or even a third seta) anterolaterally (Fig. 35C). The opisthogastric setae (c. 20 pairs) are fine and simple. Irregularly shaped granular metapodal shields are present. The peritreme extends to coxa I.

The tectum comprises three strong tapered prongs, the laterals being occasionally bifid (Fig. 35D). The chelicera is shown in figure 35E. The chaetotaxy of the palp trochanter, femur and genu is as in figure 35F. The venter of the gnathosoma is shown in figure 35G: the corniculi are strong and pointed, the palpcoxal setae finely pilose, the other three pairs simple. The setae of leg I are simple; leg II bears stouter setae ventrally and on the tarsus; leg III has similar setae and the tarsus is swollen distally; leg IV has rather more stout setae.

**MALE** The idiosoma measures 1164–1350  $\mu\text{m}$  long  $\times$  600–750  $\mu\text{m}$  wide. It is heavily sclerotized and in many specimens is constricted in the region of the transverse suture (Fig. 35H). With the possible exception of *j1*, all setae are simple, slender and finely pointed. The dorsal chaetotaxy is shown in the figure; the podonotal region bears 24 pairs of setae of which only *r3* are long. The setae of the opisthonotal region, which number approximately 45–50 pairs, are occasionally asymmetrically arranged.

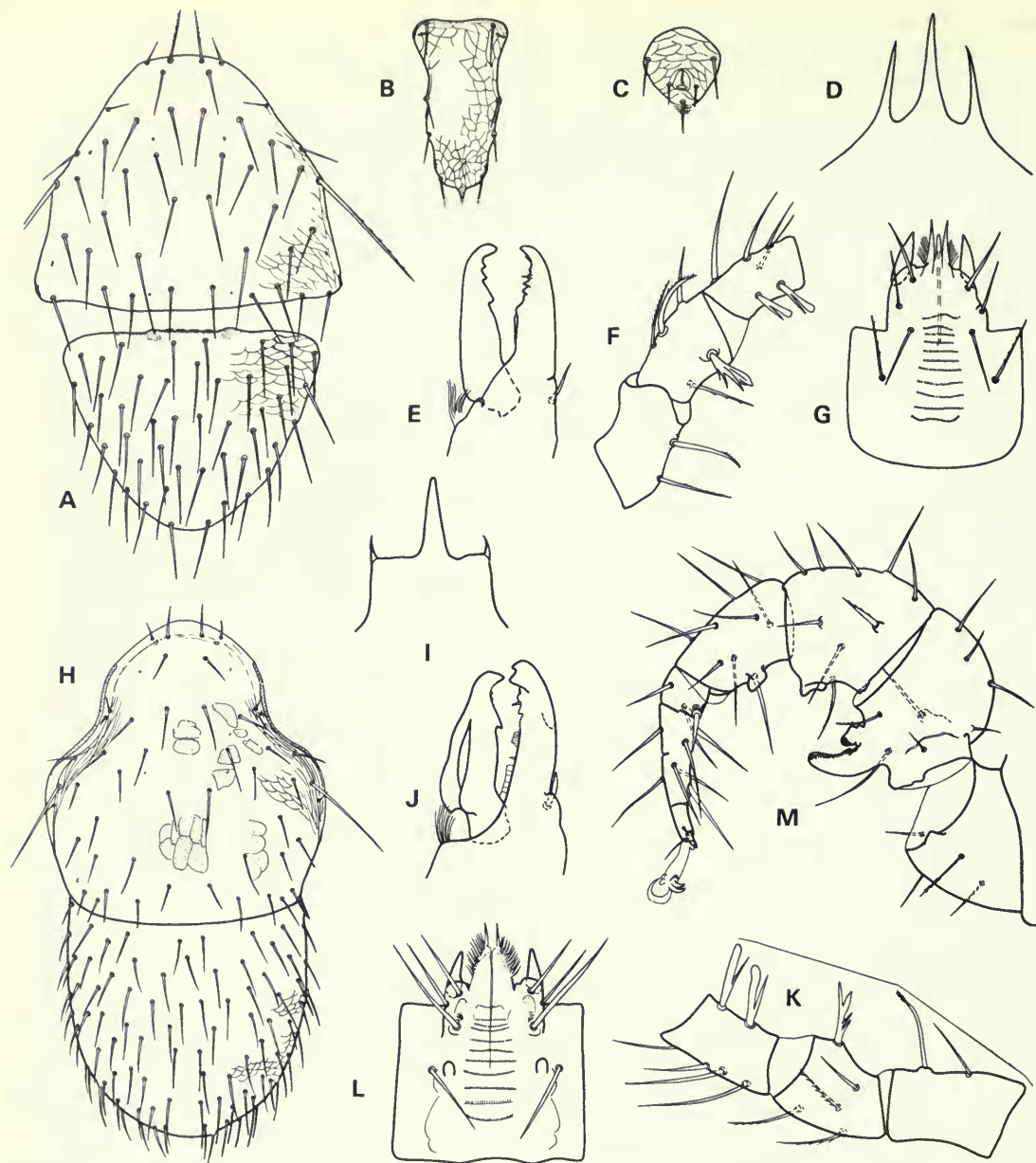


Fig. 35 *Eugamasus berlesei* Willmann, deutonymph – A dorsal shields; B sternal shield; C anal shield; D tectum; E chelicera; F palp trochanter, femur and genu; G venter of gnathosoma: male – H dorsum; I tectum; J chelicera; K palp trochanter, femur and genu; L venter of gnathosoma; M leg II.

The tritosternum has a narrow base and pilose laciniae and is flanked by characteristically shaped presternal shields. The ventral sclerotization and chaetotaxy appear identical to those of *E. magnus* (Fig. 34B).

The tectum comprises a slender pointed prong broadly shouldered at its base and with a slender incurved tooth projecting anteriorly from each shoulder (Fig. 35I). The chelicera is shown in figure 35J. Although the dentition of both digits is similar to that of *magnus*, the fixed digit is more slender and lacks the basal protuberance, and the movable digit is shorter



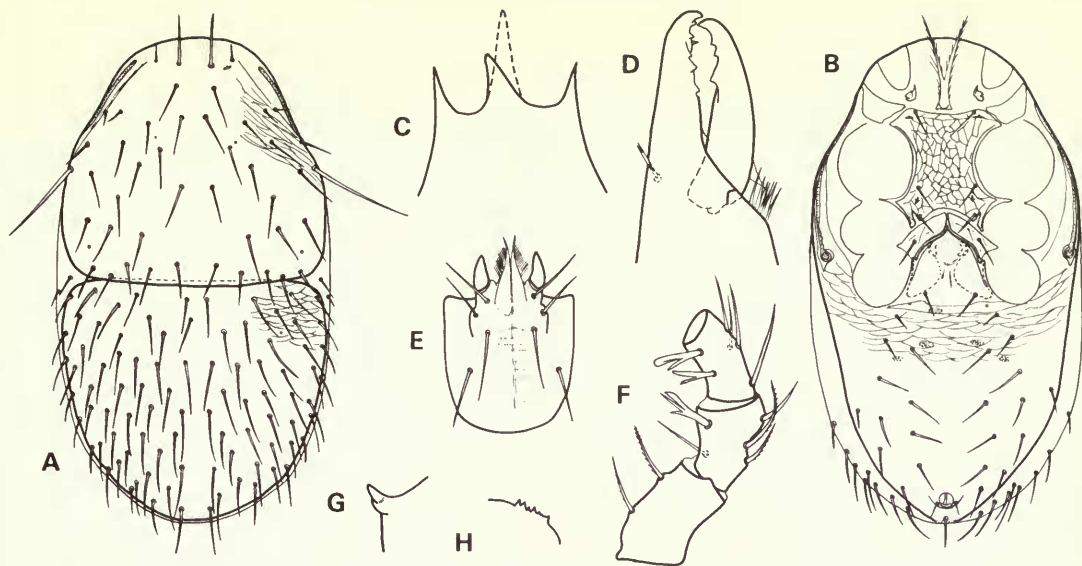


Fig. 36 *Eugamasus berlesei* Willmann, female – A dorsum; B venter; C tectum; D chelicera; E venter of gnathosoma; F palp trochanter, femur and genu; G dorsal spur of coxa I; H anterior margin of coxa of leg III.

(120  $\mu$ m). The chaetotaxy of the palp trochanter, femur and genu is shown in figure 35K. The venter of the gnathosoma is as in figure 35L. It bears a pair of protuberances adjacent to the palpcoxal setae similar to those of *magnus*. Leg II, shown in detail in figure 35M, is considerably less heavily armed than in *magnus*. The chaetotaxy of leg I (c. 1300  $\mu$ m), leg III (c. 850  $\mu$ m) and leg IV (c. 1300  $\mu$ m) are essentially as in *magnus*, but trochanter IV lacks the small dorsal protuberance.

**FEMALE.** The podonotal shield (600–700  $\mu$ m long  $\times$  624–660  $\mu$ m wide) is reticulated mainly around the lateral and posterior margins. It bears 23 pairs of slender simple setae of which *r*3 are long (Fig. 36A). The opisthonotal shield (564–660  $\mu$ m long  $\times$  636–708  $\mu$ m wide) is entirely reticulated and bears 40–50 pairs of simple setae. In the specimen figured the right side has less setae than the left.

The tritosternum has a narrow base and pilose laciniae and the small presternal shields are characteristically shaped (Fig. 36B). The sternal shield is entirely reticulated and the setae are simple. The metasternal setae are also simple. The genital shield is pointed anteriorly and bears a pair of small lateral horns. The single pair of genitals and the 11–12 pairs of opisthogastric setae are simple. The postanal seta is longer than the paranals. The nine or so pairs of setae on the interscutal membrane are also simple. The peritreme extends to coxa I.

The tectum of the specimen figured is quite a common variation although the symmetrical form shown dotted is more normal (Fig. 36C). The chelicera is as in figure 36D. The venter of the gnathosoma is shown in figure 36E: the setae are simple. The chaetotaxy of the palp trochanter, femur and genu is as in figure 36F. The setae of leg I are fine and slender: the coxa bears distally a conspicuous but small conical dorsal spur (Fig. 36G). Leg II bears stout ventral setae on the femur, genu, tibia and tarsus. Leg III bears similar but slightly less stout ventral setae, whilst on the coxa there is usually a conspicuous anterior sclerotized ridge which is either finely toothed (Fig. 36H) or plain. Leg IV also bears stout ventral setae on the genu, tibia and tarsus.

**MATERIAL EXAMINED.** 57 samples – 14 DNN, 15  $\sigma\sigma$ , 69  $\varphi\varphi$ .

**ENGLAND:** Devon, Somerset, Hampshire, Surrey, Kent, Buckinghamshire, Oxfordshire, Hertfordshire, Huntingdonshire, Cambridgeshire, Norfolk, Suffolk, Derbyshire, Lancashire, Westmorland, Yorkshire.

WALES: Monmouthshire.

SCOTLAND: Roxburghshire, Midlothian, E. Lothian, Perthshire, Angus, Isle of Mull.

IRELAND: Kerry, Clare.

The British material examined has been collected from a wide variety of habitats, e.g. deciduous and coniferous litter, mosses, rotten logs, in caves, on small mammals (mole *Talpa europaea* L. and field vole *Microtus agrestis* (L.)) and in moles' nests.

DISTRIBUTION. Previous British records of *magnus* Kramer are probably all referable to the present species. Halbert (1915) records *magnus* Kramer *teste* Berlese, 1906, from Westport, Co. Mayo, but the single specimen examined is a female of *Vulgarogamasus kraepelini*. Hull (1918) records *magnus* Kramer from Northumberland and Durham, but a single female without data in the Hull Collection is *berlesei*. Turk (1944) records *magnus* Kramer from caves in the Mendip Hills of Somerset, but a male and female examined from this collection are *berlesei*. *Eugamasus anglocavernarum* Turk, 1944, which was described from a single male, has been examined by me and I agree with Micherdzinski (1969) in synonymizing it with *berlesei*. Hazelton's (1970a) and Turk's (1972) records of a female *anglocavernarum* from Swanley, Kent, are probably referable to *berlesei*, but the specimen was not available for examination, whilst Turk's (1967) mention is probably based on his 1944 material. Further records from caves are from Somerset (Hazelton, 1967c, 1968b, c, 1970b), Breconshire (Hazelton, 1970a, 1971b), Derbyshire and Yorkshire (Hazelton, 1972).

Abroad *Eugamasus berlesei* is recorded from Belgium (Willmann, 1935, Leruth, 1939, van Daele & Heungens, 1974), Germany (Holzmann, 1969, Karg, 1965, 1971), Poland (Micherdzinski, 1969), Austria (Leitner, 1946), Switzerland (Cooreman, 1954, 1959, Schweizer, 1961), Italy (Berlese, 1906) and Western Siberia (Davydova, 1976).

### *Eugamasus cavernicola* Trägårdh (Fig. 37A–H)

*Eugamasus magnus* var. *cavernicola* Trägårdh, 1912: 524.

*Eugamasus magnus* var. *trägårdhi* Oudemans, 1913b: 373, *nom. nov. pro* *Eugamasus magnus* var. *cavernicola* Trägårdh, 1912, non *Eugamasus magnus* var. *cavernicola*, Berlese, 1909\* = *Parasitus loricatus* (Wankel) auctt. and non *Parasitus traegardhi* Micherdzinski, 1969: 567 = *Parasitellus talparum* (Oudemans).

*Parasitus cavernicola* (Trägårdh). Micherdzinski, 1969: 526.

*Parasitus cavernicolus*: Karg, 1971: 449.

*Parasitus* (*Eugamasus*) *cavernicola*: Bregetova *et al.*, 1977: 67.

*Eugamasus cavernicola*: Holzmann, 1969: 16. Athias-Henriot, 1979: 7.

For the time being, at least until more material including deutonymphs and males has been collected, I am following Karg (1971) in the separation of *Parasitus cavernicola* (Trägårdh) and *monticola* (Berlese, 1906: 179). The British specimens examined (four females) key down to *cavernicolus* (*sic*) in Karg and either *monticola* or *cavernicola* in Holzmann, but match closest the figures of *cavernicola* given first by Holzmann and then copied by Karg. Whatever the outcome of further collecting and possible rearing, at present only one species, here referred to as *Eugamasus cavernicola* Trägårdh, is recorded from the British Isles.

DEUTONYMPH AND MALE. See remarks above.

FEMALE. The podonotal shield (508–564  $\mu\text{m}$  long  $\times$  552–600  $\mu\text{m}$  wide) is entirely reticulated and bears 21 pairs of simple setae of which *r*3 (c. 210  $\mu\text{m}$ ) are the only relatively long pair (Fig. 37A). The opisthonotal shield (504–552  $\mu\text{m}$  long  $\times$  564–588  $\mu\text{m}$  wide) is also entirely

\*The name *Eugamasus magnus* var. *cavernicola* Berlese, 1909, first appears in the literature in Oudemans, 1913b: 373 and again in 1914, Heft 8: 116. It has subsequently been quoted by several authors, including Micherdzinski, 1969: 552, but it does not appear to have been published by Berlese. This is explained in a letter I have received from Dr Fausta Pegazzano dated 1 April 1977 in which she quotes from a manuscript catalogue compiled by Berlese as follows: '*Eugamasus magnus* (Kram.) Berl. var. *cavernicola* (Berl.) Oud. (Oudemans, 1913, *Ent. Ber.* 3: 373, *nomen mutavit* = var. *trägårdhi*)'. Oudemans (1913b) appears to refer to correspondence he had with Berlese in 1909 as there are in Florence specimens labelled '*E. magnus* var. *cavernicola*' collected at Maastricht, Netherlands.

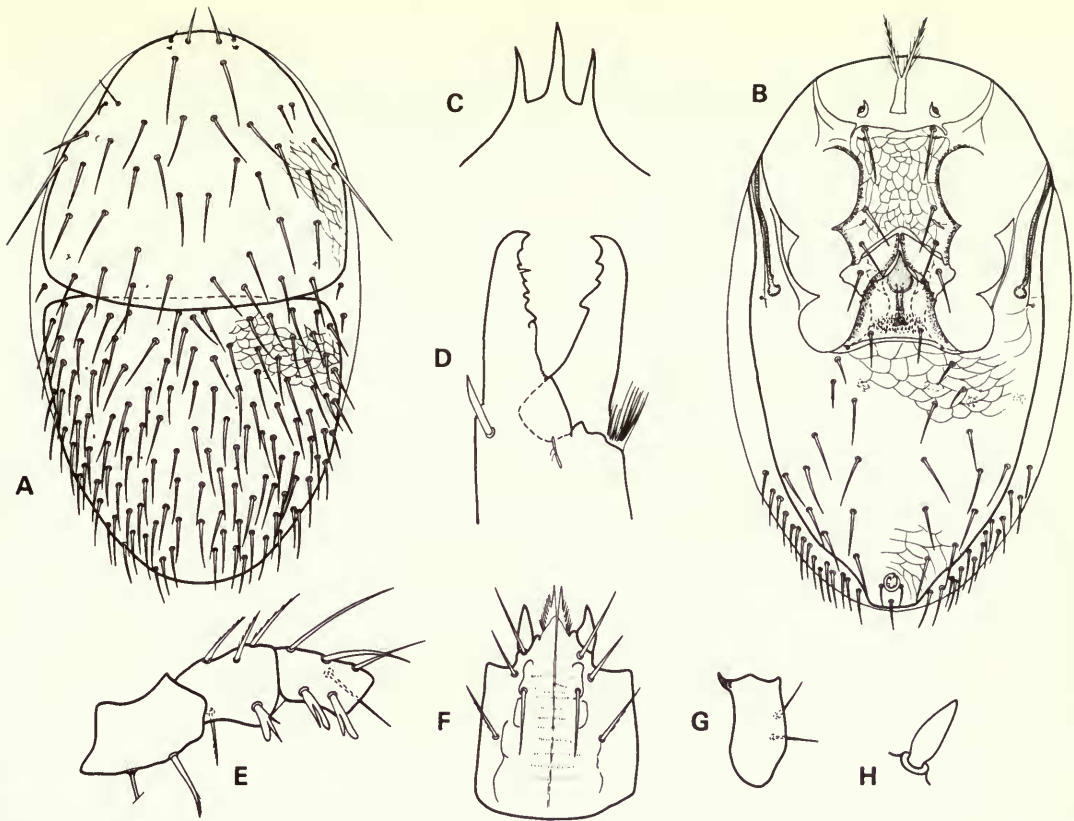


Fig. 37 *Eugamasus cavernicola* Trägårdh, female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G coxa of leg I; H ventral seta of femur of leg II.

reticulated. It bears about 60 pairs of simple setae whose distribution, whilst being fairly even, is not entirely symmetrical.

The tritosternum has a narrow base and pilose laciniae and is flanked by a pair of small crescent-shaped presternal shields (Fig. 37B). The sternal shield is somewhat narrow and is evenly reticulated. The genital shield is pointed anteriorly and bears small teeth at the 'shoulders'. The opisthogastric shield is evenly and strongly reticulated and bears eleven pairs of simple setae. The paranal setae are shorter than the postanal. The posterior interscutal membrane bears about fifteen pairs of simple setae. The peritreme extends to coxa I.

The tectum (Fig. 37C) comprises three simple slender prongs. The chelicera is shown in figure 37D, the chaetotaxy of the palp trochanter, femur and genu in figure 37E, and the venter of the gnathosoma in figure 37F. The setae on leg I are the finest, whilst those on legs II–IV are generally only slightly stouter. Coxa I bears anterodorsally a small curved spur (Fig. 37G). Femur II bears ventrally a single stout peg-like seta which arises from a small tubercle (Fig. 37H).

**MATERIAL EXAMINED.** 3 samples – 4 ♀♀.

ENGLAND: One female from the nest of a mole *Talpa europaea* L. near Froxfield, Wiltshire, 29 January 1964 and two females from beech/oak litter at Sutton Bonington, Leicestershire, in the 1960s.

SCOTLAND: One female from a mole's nest Midlothian/Roxburghshire border area, 1964.



**DISTRIBUTION.** This species has not previously been authentically recorded from the British Isles. *Eugamasus magnus* var. *monticola* has been recorded by Turk (1944, 1972) who examined two females from caves in the Mendip Hills of Somerset, two females from Co. Cork and one adult from Yorkshire and assigned them to this taxon. Unfortunately specimens could not be located for examination. Similarly, Turk's (1967) records of *monticola* and *tragardhi* have not been substantiated, nor have those of Hazelton (1967a, 1970b) from Surrey, Hazelton (1967c) from Somerset, and Hazelton (1972) from Yorkshire.

Other recorded occurrences for both *cavernicola* and *monticola* are mainly from caves and are as follows:

a, *cavernicola*: France (Trägårdh, 1912, Cooreman, 1959), Belgium (Willmann, 1935, Leruth, 1939), Germany (Willmann, 1938b, Holzmann, 1969, Karg, 1971), Switzerland (Cooreman, 1959), Hungary (Cooreman, 1951), Yugoslavia (Willmann, 1941) and Romania (Cooreman, 1951).

b, *monticola*: Germany (Holzmann, 1969, Karg, 1971) and Italy (Berlese, 1906). The record given by Schweizer (1961: 26) refers to the female of *E. berlesei* q. v.

***Eugamasus crassitarsis* (Halbert)**  
(Fig. 38A–N)

*Gamasus* (*Eugamasus*) *crassitarsis* Halbert, 1923: 363.

*Parasitus crassitarsis*: Micherdzinski, 1969: 508. Karg, 1971: 450.

*Parasitus* (*Eugamasus*) *crassitarsis*: Tichomirov, 1969: 1475. Bregetova *et al.*, 1977: 72.

*Eugamasus crassitarsis*: Athias-Henriot, 1979: 7.

**DEUTONYMPH.** Unknown.

**MALE.** The finely reticulated dorsal shield (1560–1770  $\mu\text{m}$  long  $\times$  960–1044  $\mu\text{m}$  wide) is entire, but the transverse suture extends almost to the lateral margins (Fig. 38A). Twenty-three pairs of simple setae are present on the podonotal region, the only long pair being *r*3. The opisthonotal region bears about 55 pairs of simple setae arranged very nearly symmetrically.

The tritosternum has a long base and pilose laciniae. The sternogenital setae are simple as are the symmetrically arranged 20 or more pairs of opisthogastric setae (Fig. 38B). The three anal setae are fine, short and of equal length. The peritreme extends to the level of coxa I.

The tectum (Fig. 38C) comprises three pointed prongs, the central one being long and parallel sided, the two lateral ones very short. The chelicera is as in figure 38D. The palp trochanter, femur and genu are shown in figure 38E: the anterolateral seta on the femur is five-tined whilst the two anterolateral setae on the genu are bifid. The corniculi are bold, stalked and slightly diverging (Fig. 38F): the gnathosomal setae are simple and up to 12 rows of hypognathal denticles are visible. Leg II is shown in detail in figure 38G: the inflated but finely attenuated spine on the tarsus frequently has the filamentous part broken off (see Schweizer, 1961, fig. 26c).

**FEMALE.** The podonotal shield (768–800  $\mu\text{m}$  long  $\times$  696–732  $\mu\text{m}$  wide) bears 23 pairs of setae and, like the male, only *r*3 are long. The opisthonotal shield (672–800  $\mu\text{m}$  long  $\times$  684–880  $\mu\text{m}$  wide) bears over 50 pairs of setae arranged almost symmetrically. Both shields are finely reticulated over their entire surfaces (Fig. 38H). The posterior interscutal membrane bears half a dozen or so simple setae.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of characteristically shaped presternal shields (Fig. 38I). The sternal and metasternal shields are granular with faint reticulations. The posterior margin of the sternal shield is irregularly concave. The sternal, metasternal and genital setae are simple. The genital shield is pointed anteriorly and bears a pair of prominent lateral teeth. The main features of the endogynium are shown through the genital shield. The strongly reticulated opisthogastric shield bears 12 pairs of simple setae and the posterior membrane from seven to 10 setae on each side that are not always paired. The postanal seta is longer than the paranals. The peritreme extends anteriorly to the level of coxa I.

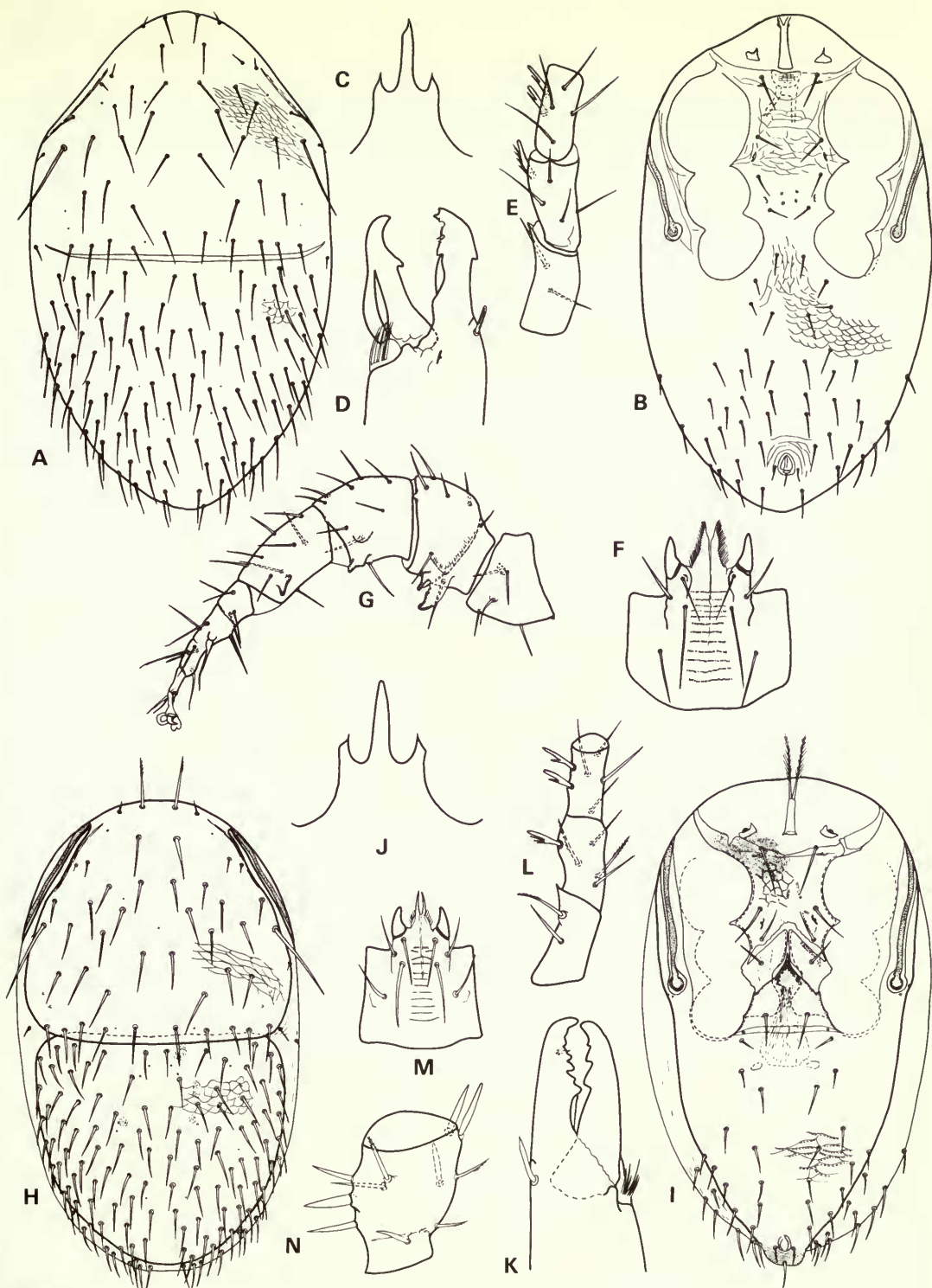


Fig. 38 *Eugamasus crassitarsis* (Halbert), male – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G leg II; female – H dorsum; I venter; J tectum; K chelicera; L palp trochanter, femur and genu; M venter of gnathosoma; N femur of leg II.

The tectum (Fig. 38J) is almost identical to that of the male. The chelicera is shown in figure 38K, and the palp trochanter, femur and genu in figure 38L. The venter of the gnathosoma is shown in figure 38M: the setae are simple. All setae on the legs are simple, or at the most, traces of pilosity are just discernible. A number of the ventral setae are stouter and clearly smooth, for example on trochanter and femur I, femur – tarsus II, trochanter – tarsus III and IV. Femur II is shown in figure 38N.

**MATERIAL EXAMINED.** 17 samples – 9 ♂♂, 9 ♀♀.

ENGLAND: Gloucestershire, Hampshire, Surrey, Berkshire, Hertfordshire, Lancashire, Yorkshire, Northumberland.

IRELAND: Wexford, Kildare, Dublin, Meath, Mayo.

All samples comprise single specimens except the Hampshire one which comprises one male and one female.

This large, scarce, species was originally described (Halbert, 1923) from two males found under a stone on the seashore at high tide mark in Co. Wexford, 12 March 1922. I have examined two males on slides in the Halbert Collection, one labelled according to Halbert's description, the other labelled 'Glasnevin [Dublin], amongst soil, 31.3.'22' in Halbert's writing. Fresh material examined is from grass cuttings, leaf litter (mainly oak), arable land, pasture on sandy soil, grass on chalk, barley on sandy soil and mossy coniferous litter.

**DISTRIBUTION.** Previous British records are those of Halbert (1923) and a more recent record by Curry (1969) from grassland in Co. Kildare.

It is recorded from Belgium (van Daele & Heungens, 1974), Germany (Karg, 1971), Switzerland (Schweizer, 1961) and Poland (Micherdzinski, 1969).

#### Genus *PORRHOSTASPIS* Müller

*Porrhostaspis* Müller, 1859. *Lotos* 9: 28.

**TYPE SPECIES** *Porrhostaspis lunulata* Müller, 1859.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields. Setae *z5* of dorsal hexagon longest and strongest in the deutonymph and female, scarcely different from *j5* and *j6* in the male. Tritosternum biramous in deutonymph and adults. Junction between sternal and metasternal shields in female oblique. Genital shield of female elongate, tricuspid anteriorly. Opisthogaster of female bearing about 15 pairs of setae, male and deutonymph with about 14 and 20 pairs respectively. Seta *al* of palp femur spiculate on one margin; setae *al*<sub>1</sub> and *al*<sub>2</sub> of palp genu entire, spatulate. Male chelicerae asymmetrical due to presence of variable digitiform process on the spermatodactyl of the right chelicera. Corniculi in the deutonymph and female short, entire; in the male longer; cleft on the inner margin. Legs of deutonymph and female without spurs; only leg II of male spurred. Lobes of pulvilli normal, rounded.

#### *Porrhostaspis lunulata* Müller (Figs 39A–P; 40A–H)

*Porrhostaspis lunulata* Müller, 1859: 29. Samšiňák, 1960: 275. Evans & Till, 1979: 209.

*Eugamasus lunulatus* (sic): Schweizer, 1961: 30.

*Eugamasus lunulatus*: Hirschmann, 1957: 15, III. Holzmann, 1969: 17.

*Parasitus lunulatus*: Micherdzinski, 1969: 455. Karg, 1971: 449.

*Parasitus* (*Eugamasus*) *lunulatus*: Tichomirov, 1969: 1475. Bregetova *et al.*, 1977: 62, 67.

*Paracarpais* (*Eteocarpais*) *lunulata*: Athias-Henriot, 1978: 48.

*Gamasus cornutus* G. & R. Canestrini, 1882: 48.

*Parasitus cornutus*: Oudemans, 1902b: 34.



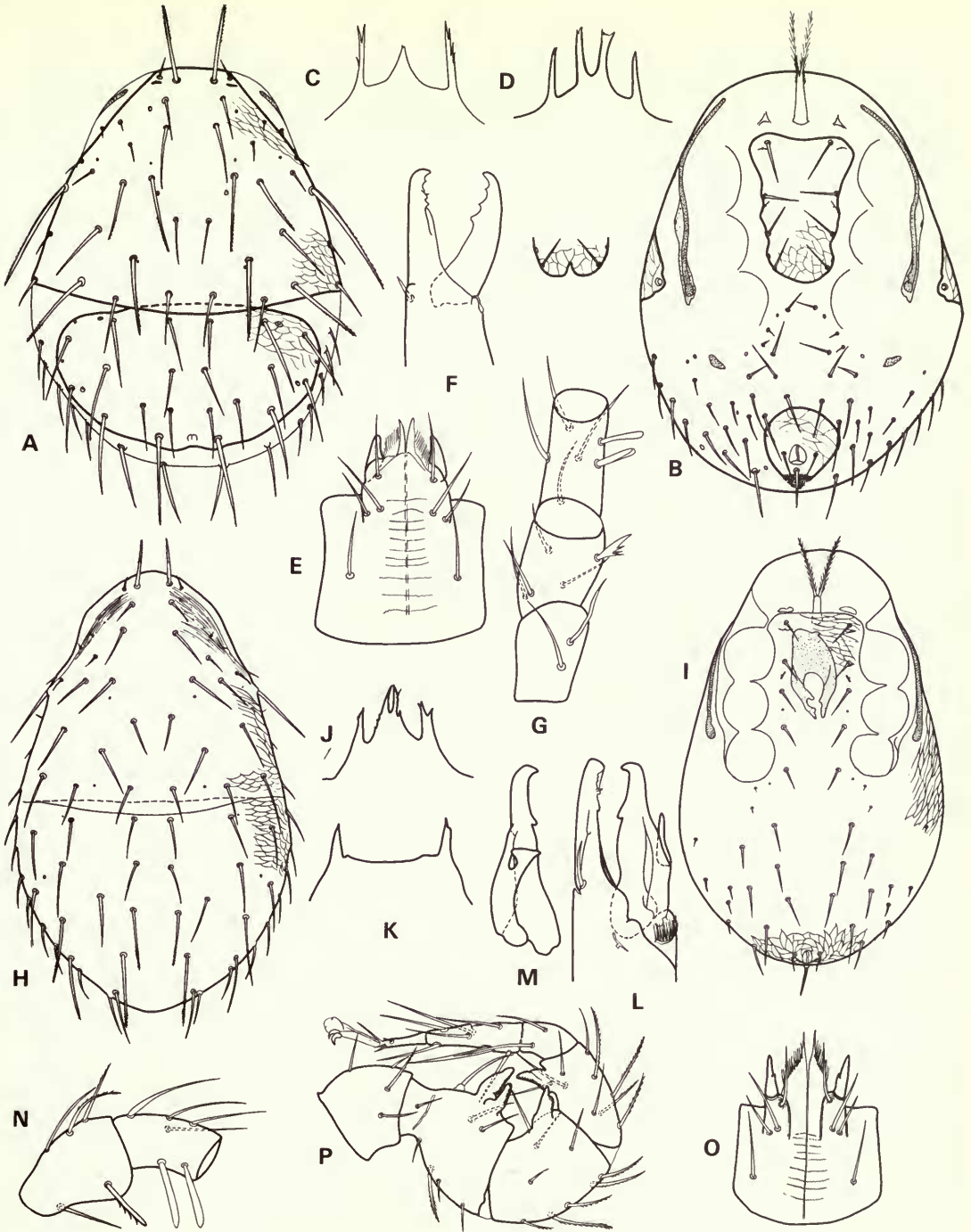


Fig. 39 *Porrhostaspis lunulata* Müller, deutonymph - A dorsum; B venter; C, D tectum; E venter of gnathosoma; F chelicera; G palp trochanter, femur and genu: male - H dorsum; I venter; J tectum (typical); K tectum (extreme variation); L right chelicera (typical); M movable digit of right chelicera (variation); N palp femur and genu; O venter of gnathosoma; P leg II.

*Gamasus (Eugamasus) cornutus*: Berlese, 1906: 173.

*Eugamasus epsilon*: Oudemans & Voigts, 1904 in Voigts & Oudemans, 1904: 654.

*Parasitellus ferox* (Trägårdh, 1910) sensu Turk & Turk, 1952: 478 = *Porrhostaspis lunulata* (Müller, 1859) and *Parasitus loricatus* (Wankel, 1861), non Trägårdh, 1910 = *Parasitellus fucorum* (De Geer, 1778).

**DEUTONYMPH.** In this species the deutonymph is, in contrast to the adults, generally very weakly sclerotized and frequently the dorsal shields and the sternal shield are rather irregularly formed. The podonotal shield (360–450  $\mu\text{m}$  long  $\times$  560–570  $\mu\text{m}$  wide) is finely reticulated and bears 19 pairs of setae, most of which are long and broad with fine pilosity (Fig. 39A). The opisthonotal shield (240–275  $\mu\text{m}$  long  $\times$  432–470  $\mu\text{m}$  wide) is also finely reticulated. It bears 10 pairs of long setae, and the surrounding membrane between five and eight pairs, the posterior two of which are the longest.

The tritosternum, which has a narrow base and pilose laciniae, may be flanked by a pair of small triangular presternal shields (Fig. 39B). The sternal shield is reticulated and may be indented posteriorly (see inset to the figure). The sternal setae become progressively shorter from I–IV. The anal shield is circular with a posterior taper and the postanal seta is the longest. The opisthogastric membrane bears from 16 to over 20 pairs of setae, those surrounding the anus being the longest. Faint metapodal shields are sometimes present. The peritreme extends to coxa I.

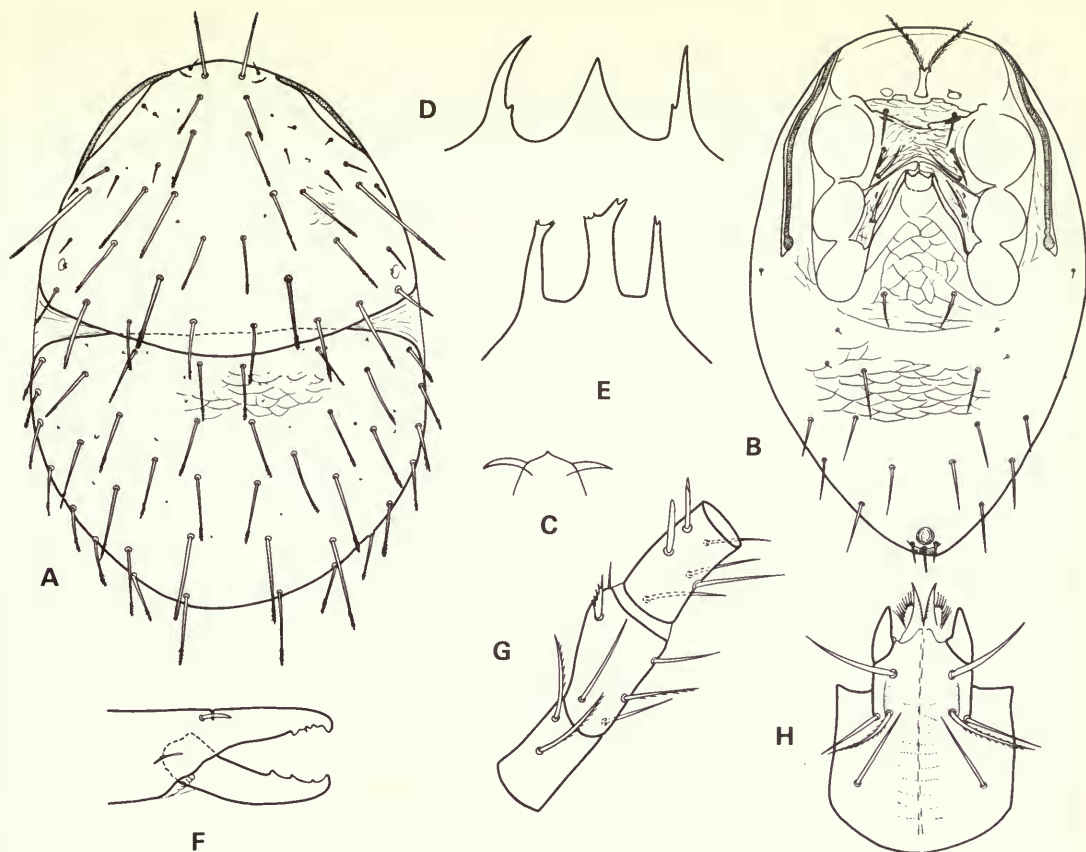
Two forms of tectum are shown in figures 39C and D. The venter of the gnathosoma is as in figure 39E, the chelicera in figure 39F, and the chaetotaxy of the pedipalp in figure 39G. The leg setae are generally long and simple, although some are very finely pilose. Tarsus IV bears a long seta (c. 67  $\mu\text{m}$ ) dorsally.

**MALE.** The male of this species is one of the most heavily sclerotized members of the Parasitinae. The dorsum is completely covered by a dark yellowish-brown reticulated shield which is divided by a transverse suture running almost the full width of the idiosoma and results in the anterior portion often overlapping the posterior (Fig. 39H). The idiosoma averages 948–1100  $\mu\text{m}$  long  $\times$  630–800  $\mu\text{m}$  wide. The podonotal region bears 21 pairs of setae distributed as illustrated. Their lengths appear constant, in contrast to the female where considerable variation has been observed. The opisthonotal region bears 20 pairs of setae which also show almost no variation. Many of the longer setae are extremely finely pilose for much of their length.

The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of elliptical presternal shields. The genital lamina is characteristically shaped and often appears to be haphazardly situated beneath the anterior half of the sternogenital shield (Fig. 39I). The sternogenital setae are simple. The entire venter is strongly sclerotized and bears, posterior to coxae IV, 14 pairs of setae in addition to those associated with the anus. Several pairs are extremely short and their location is shown in the figure. The paranal setae are fine and are just over half the length of the stouter postanal seta. The peritreme extends anteriorly to the level of coxa I or slightly beyond.

A typical tectum is illustrated in figure 39J. However, there is a range of variation and an extreme form is shown in figure 39K. The male chelicerae in this species are unusual in that the right spermatodactyl has a digitiform protuberance which is usually smoothly tapered (Fig. 39L), although occasionally shaped otherwise (Fig. 39M). The left spermatodactyl is smooth and without trace of irregularity. The chaetotaxy of the palp femur and genu is as in figure 39N. The stalked corniculi are straight and narrow and are notched on the inner margin (Fig. 39O). The gnathosomal setae are simple. Leg II is shown in detail in figure 39P. No significant variation has been encountered. Most of the other leg setae are long and many are extremely finely pilose.

**FEMALE.** The reticulated podonotal shield (504–576  $\mu\text{m}$  long  $\times$  588–756  $\mu\text{m}$  wide) bears 21 pairs of setae of which the majority are long, but not constantly so, and very finely pilose, the longest,  $r_3$  being up to 240  $\mu\text{m}$  (Fig. 40A). The opisthonotal shield (432–540  $\mu\text{m}$



**Fig. 40** *Porrostaspis lunulata* Müller, female—A dorsum; B venter; C apex of genital shield showing extreme variation; D, E tectum; F chelicera; G palp trochanter, femur and genu; H venter of gnathosoma.

long  $\times$  552–708  $\mu$ m wide) is also completely reticulated. It bears 19 pairs of long setae, mainly very finely pilose.

The tritosternum has pilose laciniae and a narrow base. It is flanked by a pair of small but conspicuous presternal shields. The short sternal shield is normally not evenly sclerotized, the portion anterior to the first pores, and bearing setae I, being more lightly sclerotized than the remainder (Fig. 40B). The metasternal shields are obliquely narrowed, their setae being more slender than the sternals. The genital shield is broad and long and its apex is normally trispinate. Considerable variation occurs in the outline of the apex, the trident often being malformed or missing. An extreme variation is shown in figure 40C, a specimen in the J. E. Hull collection from Hylton, Co. Durham. The genital setae are slender and simple. The opistogastric shield bears eight pairs of setae, two posterior to coxae IV being minute, the remainder long. The surrounding membrane bears generally seven pairs of setae. The postanal seta is longer than the paranals. The peritreme extends anteriorly to coxae I.

The tectum is broad and trispinate, but shows considerable variation in the form of the tines (Figs 40D, E). The chelicera is shown in figure 40F, and the chaetotaxy of the palp trochanter, femur and genu in figure 40G. The four pairs of gnathosomal setae are of approximately equal length and stoutness, but the internal posterior hypostomatics are finely pilose (Fig. 40H). Eleven rows of hypognathal denticles are usually clearly defined. The leg setae are mainly long and many are extremely finely pilose.

**MATERIAL EXAMINED.** 142 samples –21 DNN, 70  $\sigma\sigma$ , 163  $\varphi\varphi$ .

ENGLAND: Isles of Scilly, Cornwall, Devon, Somerset, Dorset, Gloucestershire, Steep Holm



(Bristol Channel), Isle of Wight, Hampshire, Sussex, Surrey, Kent, Buckinghamshire, Middlesex, Hertfordshire, Essex, Suffolk, Cambridgeshire, Leicestershire, Nottinghamshire, Warwickshire, Staffordshire, Worcestershire, Cheshire, Lancashire, Westmorland, Cumberland, Yorkshire, Northumberland, Durham.

WALES: Monmouthshire, Glamorganshire, Caernarvonshire.

SCOTLAND: Roxburghshire, Midlothian, East Lothian, Dunbartonshire, Perthshire, Argyllshire, Inverness-shire, Inner Hebrides (Eigg), Outer Hebrides (St Kilda).

IRELAND: Kildare, Clare, Mayo, Sligo.

CHANNEL ISLANDS: Jersey.

This widespread European species is distributed throughout the British Isles and is found in a wide range of habitats and situations. Leafmould, flood debris and mosses, under bark, in grassland, compost and mushroom beds are the more frequent biotopes. I have examined one deutonymph from seaweed. There are several records from the fur of *Apodemus sylvaticus* (L.) and one is from a 'baby bat', Devon, 14 July 1963, coll. A. J. Sutcliffe, but this species has not normally been encountered as a nest inhabitant in this country. Turk (1972) records it from caves. It has been recorded from small mammals in Czechoslovakia (Mrciak & Rosický, 1956, Rupeš, 1965) and Poland (Willmann, 1952*b*), whilst Cooreman (1960) has recorded it from bat guano in Afghanistan.

DISTRIBUTION. Previous British records are from Co. Dublin (Halbert, 1915), the Tyne Province and Scotland (no precise locality) (Hull, 1918), Isle of Lewis, Outer Hebrides (Hora, 1934), the Inner Hebrides (Bertram, 1939), the Channel Islands (Browning, 1956), South Wales (Bhattacharyya, 1962), Buckingham Palace Garden (Bristowe, 1964), Westmorland (Block, 1965), Co. Kildare (Curry, 1969), Huntingdonshire (Davis, 1970), Somerset and Surrey (Turk, 1972), Somerset (Hazelton, 1971*a, b*), and Devon, Breconshire and Shropshire (Hazelton, 1971*b*). The record of *Parasitellus ferox* (Trägårdh) from the Isle of Wight (Turk & Turk, 1952) is referable to the present species.

It is recorded from Iceland (Sellnick, 1940), Finland (Nordberg, 1936), Holland (Oudemans, 1902*b*), Belgium (Willmann, 1935, Leruth, 1939, Cooreman, 1943, van Daele & Heungens, 1974, 1975), France (Cooreman, 1959), Germany (Voigts & Oudemans, 1905, Poppe, 1906, Schweizer, 1926, Holzmann, 1969, Karg, 1965, 1971), Switzerland (Schweizer, 1949, 1961), Italy (G. & R. Canestrini, 1882, Berlese, 1906, Valle, 1955, Cooreman, 1959), Austria (Franz, 1943, Leitner, 1946), Czechoslovakia (Müller, 1859, 1860, Vitzthum, 1925, Pax & Maschke, 1935, Willmann, 1954, Mrciak & Rosický, 1956, Halašková, 1959, Rupeš, 1965), Poland (Schweizer, 1925, Willmann, 1952*b*, Micherdzinski, 1969), the U.S.S.R. (Bregotova, 1956), and Afghanistan (Cooreman, 1960).

#### Genus *CORNIGAMASUS* Evans & Till

*Cornigamasus* Evans & Till, 1979. *Trans. zool. Soc. Lond.* **35**: 209.

TYPE SPECIES. *Gamasus coleoptratorum* var. *lunaris* Berlese, 1882*a*.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields. Setae *z*5 of dorsal hexagon different in form from *j*5 and *j*6. Tritosternum of male absent, that of deutonymph and female biramous. Junction between metasternal and sternal shields of female oblique. Genital shield of female subtriangular. Opisthogaster usually with less than 15 pairs of setae. Seta *al* of palp femur setose, at most spiculate distally; setae *al*<sub>1</sub> and *al*<sub>2</sub> of palp genu spatulate. Male chelicerae symmetrical. Corniculi long, slender, parallel, extending beyond anterior margin of palp trochanter, grooved to accommodate 'salivary' styli. Legs of deutonymph and female without spurs; only leg II of male with spurs. Lobes of pulvilli normal, rounded.

#### *Cornigamasus lunaris* (Berlese) (Fig. 41A-N)

*Gamasus coleoptratorum* var. *lunaris* Berlese, 1882*a*: 125.

*Gamasus fucorum* var. *lunaris* Berlese, 1882b: 640.

*Gamasus* (*Gamasus*) *lunaris*: Berlese, 1906: 147.

*Parasitus lunaris*: Sellnick, 1940: 23. Schweizer, 1961: 17. Micherdzinski, 1969: 437. Karg, 1971: 446.

*Parasitus* (*Coleogamasus*) *lunaris*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 85, 89.

*Eugamasus lunaris*: Holzmann, 1969: 14.

*Cornigamasus lunaris*: Evans & Till, 1979: 209.

*Parasitus spinipediformis* Trägårdh, 1904: 37. Micherdzinski, 1969: 437.

**DEUTONYMPH.** The reticulated dorsal shields are strongly sclerotized and are usually a rich yellowish-brown in colour. The posterior margin of the podonotal shield is convex medially and the protrusion fits closely into the concave anterior margin of the opisthonotal shield (Fig. 41A). The podonotal shield (384–430  $\mu\text{m}$  long  $\times$  312–379  $\mu\text{m}$  wide) bears 18 pairs of setae, none of which is long or stout. Setae *j1*, *z5* and *r3* are up to 45  $\mu\text{m}$  long and the remainder up to 38  $\mu\text{m}$ . A narrow band of cuticle is situated across the anterior margin of the shield. The opisthonotal shield (156–197  $\mu\text{m}$  long  $\times$  264–324  $\mu\text{m}$  wide) bears 12 pairs of setae of which *J5* and *Z3* are a little stouter than the remainder and are finely pilose distally.

The tritosternum has long laciniae and is flanked by strong elongate presternal shields. The sternal shield (c. 245  $\mu\text{m}$  long) is strongly sclerotized and is broad and convex anteriorly (Fig. 41B). The anal shield is elliptical and the anal setae are of equal length. Small metapodal shields are conspicuous and the opisthogastric membrane bears simple setae. The peritreme extends anteriorly to the level of coxa I.

The tectum is shown in figure 41C. The chelicera bears a lateral tooth on the fixed digit (Fig. 41D). The rest of the gnathosoma, the corniculi and the ventral setae, and the chaetotaxy of the pedipalp are the same as in the adults (Figs 41L, M). The anterolateral seta on the palp femur is not modified, but those of the genu are broad and spatulate distally. All leg setae are simple although a few, mainly on tarsi II–IV, are strong. Coxa III bears in this stage, and also in the adults, a small tubercle (Fig. 41N).

**MALE.** The idiosoma is completely sclerotized although dorsally the podonotal region is separated from the opisthonotal region by a complete transverse suture which undulates as in the female (Fig. 41H). The anterior portion measures 408–420  $\mu\text{m}$  long and the posterior 336–348  $\mu\text{m}$ . The width is 396–408  $\mu\text{m}$ . The dorsal chaetotaxy is as in the female with the addition, in the opisthonotal region, of setae that would otherwise be located on the membrane. Setae *j1*, *j4*, *z5*, *r3*, *Z1*, *Z3* and *J5*, and one additional posterior pair, are stout and pilose, the remainder being very fine and simple.

The tritosternum is absent (Fig. 41E). The genital lamina is flanked by a pair of sometimes fragmented presternal shields. The sternogenital setae are simple and the shield is separated from the opisthogastric region by a narrow suture. There are 11–14 or more pairs of setae in the opisthogastric region of which two pairs, flanking the anus, are stout and pilose. The three anal setae are short and fine. The peritreme extends to coxa I.

The tectum is as in the female (Fig. 41J). The chelicera is shown in figure 41F. The chaetotaxy of the pedipalp, the long corniculi (although slightly stalked in this sex), and the venter of the gnathosoma, are as in the female (Figs 41L, M). Leg II is shown in figure 41G. The setae of the remaining legs are simple. Coxa III bears, in common with the deutonymph and female, a small tubercle (Fig. 41N).

**FEMALE.** The podonotal shield (408–444  $\mu\text{m}$  long  $\times$  384–432  $\mu\text{m}$  wide) bears 21 pairs of setae. The majority are very short and fine, but *j1*, *j4*, *z5* and *r3* are long, stout and pilose. The posterior margin of the shield is undulating and convex medially, and closely abuts the concave anterior margin of the opisthonotal shield (Fig. 41H). The opisthonotal shield (372–384  $\mu\text{m}$  long  $\times$  348–432  $\mu\text{m}$  wide) bears 12 pairs of setae of which *Z1*, *Z3* and *J5* are long, stout and pilose.

The tritosternum has pilose laciniae and is flanked by a pair of wedge-shaped presternal shields (Fig. 41I). The sternal setae are of equal thickness, but the metasternals are more slender. The sternogenital region is not heavily sclerotized and the metasternal shields are often not clearly demarcated from the sternal shield. The genital shield is narrowly pointed

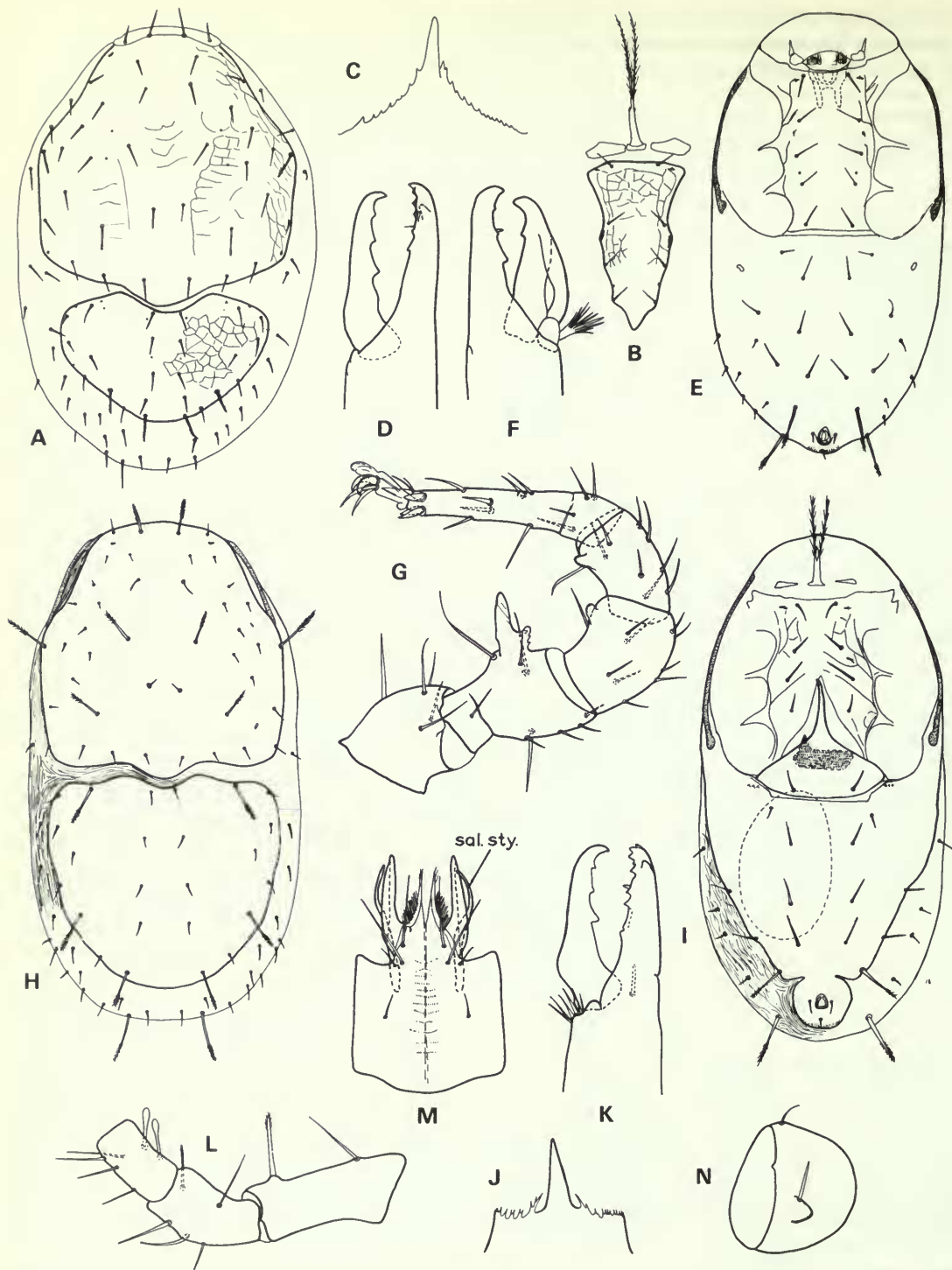


Fig. 41 *Cornigamasus lunaris* (Berlese), deutonymph - A dorsum; B sternal shield and tritosternum; C tectum; D chelicera: male - E venter; F chelicera; G leg II: female - H dorsum; I venter; J tectum; K chelicera; L palp trochanter, femur and genu; M venter of gnathosoma including 'salivary' styli, *sal. sty.*; N. coxa of leg III.



for half its length and the setae are simple. The most conspicuous part of the endogynium comprises a transversely situated granular band with a forward-protruding tongue on one side only. The tapered opisthogastric shield is often incised anterior to the anus. The opisthogastric shield bears seven pairs of setae, one pair immediately posterior to the genital shield is short, the remainder are longer with the pair nearest to the anus stout and pilose. The anal setae are short and fine. The opisthogastric membrane bears about four pairs of setae of which the posterior pair is also stout and pilose. The peritreme extends anteriorly to the level of coxa I.

The tectum (Fig. 41J) comprises a long smooth central prong emerging from a denticulate base. The chelicera is shown in figure 41K. Like the deutonymph, the fixed digit bears a lateral tooth, but in addition there is a small terminal tooth. The palp trochanter, femur and genu are shown in figure 41L and the venter of the gnathosoma in figure 41M. The corniculi are long and slender, reaching the midpoint of the palp femur. The leg setae are simple. Coxa III bears a small protuberance (Fig. 41N).

**MATERIAL EXAMINED.** 63 samples – 266 DNN, 38 ♂♂, 32 ♀♀.

ENGLAND: Cornwall, Isles of Scilly, Dorset, Hampshire, Sussex, Surrey, Kent, London, Middlesex, Hertfordshire, Essex, Norfolk, Cambridgeshire, Berkshire, Buckinghamshire, Cheshire, Lancashire, Northumberland.

WALES: Anglesey, and North Wales, no precise locality, see below.

SCOTLAND: Mull.

IRELAND: Clare, Kildare, Meath.

This species is found mainly in compost heaps, vegetable refuse, manure, haystacks and the like. Halbert (1915, 1920) records it from decaying seaweeds on the seashore but observes that this may not be its normal habitat.

**DISTRIBUTION.** Previous British records are from the Tyne Province and Cheshire (Hull, 1918), Co. Mayo (Halbert, 1915), Co. Dublin (Halbert, 1920), the Inner Hebrides (Bertram, 1939); and North Wales (Hill & Gordon, 1945) where the precise localities could not be published at the time. The material was from straw used to stuff the palliasses of American servicemen stationed in the area. The authors had been informed that *Parasitus lunaris* was a junior synonym of *Poecilochirus spinipes* (= *Gamasodes spiniger*), but apart from this being incorrect, I have examined a single deutonymph of *lunaris* from this collection.

It is recorded from Greenland (Trägårdh, 1904, Jorgensen, 1934), Iceland (Sellnick, 1940), Norway (Berlese, 1906), Sweden (Sellnick, 1958), Holland (Oudemans, 1913c), Belgium (van Daele & Heungens, 1974, 1975), Germany (Voigts & Oudemans, 1905, Karg, 1965, 1971, Holzmann, 1969), Austria (Leitner, 1946), Poland (Micherdzinski, 1969), Switzerland, (Schweizer, 1922, 1949, 1961), Italy (G. & R. Canestrini, 1882, Berlese, 1906), U.S.S.R.: Leningrad district (Vysockaja & Bregetova, 1957), Western Siberia (Davydova, 1969, 1976) and Israel (Shulov, 1957, Costa, 1966).

### Genus *PARASITELLUS* Willmann

*Parasitellus* Willmann, 1939. *Abh. naturw. Ver. Bremen* **31**: 534.

*Parasitus* (*Parasitus*): Tichomirov, 1969. *Zool. Zh.* **48**: 1332.

**TYPE SPECIES.** *Eugamasus*(?) *ferox* Trägårdh, 1910 = *Acarus fucorum* De Geer, 1778.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields. Setae *z5* of dorsal hexagon usually longer than *j5* and *j6*. Tritosternum normal, biramous, that of male not closely associated with genital orifice. Junction between sternal and metasternal shields of female oblique. Genital shield of female subtriangular. Opisthogaster with usually more than 40 pairs of setae. Setae *al* of palp femur usually strongly multifid, or at least pectinate; setae *al*<sub>1</sub> and *al*<sub>2</sub> of palp genu entire, spatulate. Male chelicerae symmetrical. Corniculi in the deutonymph and female short, entire, in the male longer, cleft on the inner margin. Legs of deutonymph and female without spurs; only leg II of male spurred. Lobes of pulvilli normal, rounded.

***Parasitellus fucorum* (De Geer)**  
(Figs 42A–N; 43A–F)

*Acarus fucorum* De Geer, 1778: 112.

*Gamasus (Gamasus) fucorum*: Berlese, 1906: 160.

*Parasitus fucorum*: Vitzthum, 1930a: 15. Schweizer, 1949: 14; 1961: 14. Colombo, 1961.

Micherdzinski, 1969: 591. Holzmänn, 1969: 28. Karg, 1971: 447. Davydova, 1976: 55.

*Parasitus (Parasitus) fucorum*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 72, 74.

*Parasitellus fucorum*: Evans & Till, 1979: 209.

*Parasitus bomborum* Oudemans, 1902b: 33; 1906: 237. Vitzthum, 1930a: 15.

*Pergamasus bomborum*: Voigts & Oudemans, 1905: 228.

*Eugamasus(?) ferox* Trägårdh, 1910: 395. Holzmänn, 1969: 28.

*Parasitellus ferox*: Willmann, 1939b: 533. Non Turk & Turk, 1952: 478 = *Porrhostaspis lunulata* and *Parasitus loricatus*.

*Gamasus bombianus* Hull, 1917: 109. Micherdzinski, 1969: 591.

*Gamasus nidicolens* Hull, 1917: 110. Micherdzinski, 1969: 591.

*Gamasus fucarius* Hull, 1918: 86. Micherdzinski, 1969: 591.

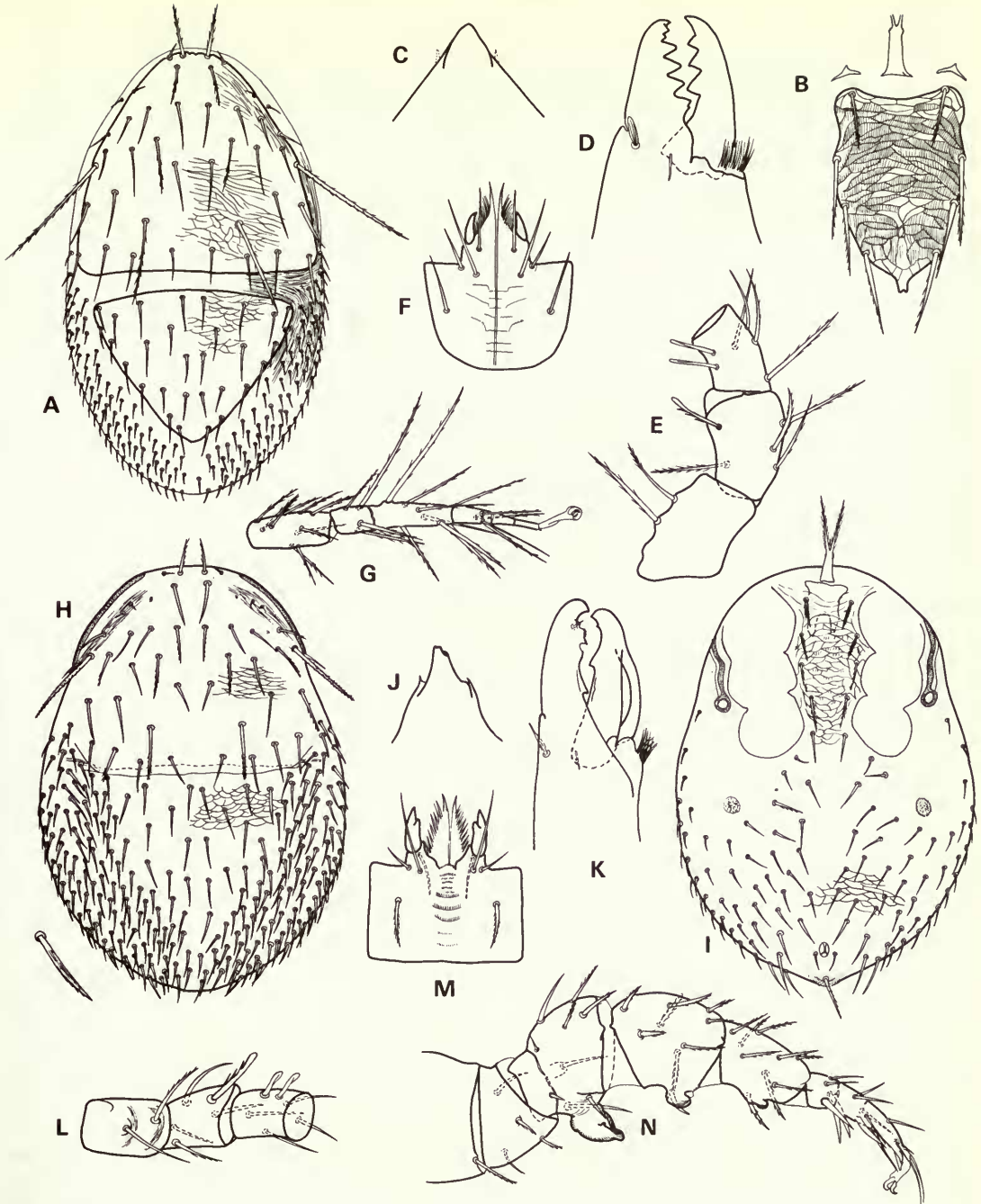
**DEUTONYMPH.** The podonotal shield (492–516  $\mu\text{m}$  long  $\times$  540–576  $\mu\text{m}$  wide) is entirely covered by narrow reticulations and is strongly sclerotized (Fig. 42A). It bears 20 pairs of setae, *s2* being situated off the shield. Many of the setae are sparsely pilose at least on one margin. Setae *z5* and *r3* are the longest. The opisthonotal shield (336–360  $\mu\text{m}$  long  $\times$  444–456  $\mu\text{m}$  wide) is triangular in outline and bears 15 pairs of homogeneous setae which normally lack pilosity. Being considerably narrower than the podonotal shield, the opisthonotal is surrounded by a broad area of membrane and this is densely clothed with short simple setae.

The tritosternum has a narrow base and is flanked by a pair of angular presternal shields. The broad reticulated sternal shield (276–300  $\mu\text{m}$  long) is conspicuously marked by fine striations, usually in its entirety, though sometimes with the portion anterior to sternal pores I clear (Fig. 42B). The four pairs of sternal setae, of which *st. I* are the finest, are pilose to a large degree. The anal shield is oval and reticulated with the postanal seta broader than the paranals. Granular elongate metapodal plates are present. The opisthogastric setae are relatively dense, similar to those on the dorsal membrane, but most are attached by small sclerotized plates, often barely larger than the setal bases. The peritreme extends to coxa I.

The tectum is shown in figure 42C, it varies in outline and may have a single tooth each side. The chelicerae bear very strong clear teeth (Fig. 42D). The chaetotaxy of the palp trochanter, femur and genu is as in figure 42E. The venter of the gnathosoma is shown in figure 42F, the corniculi are generally curved inwards at their tips. Most leg setae are strong and may be pilose at least in part. Tarsus IV has two conspicuous dorsal setae 300–320  $\mu\text{m}$  in length (Fig. 42G).

**MALE.** The idiosoma of the specimen figured measures 1575  $\mu\text{m}$  long  $\times$  1110  $\mu\text{m}$  wide. It is entirely reticulated, with a transverse median suture (Fig. 42H). The podonotal setae are largely pilose to some degree, setae *z5* (190  $\mu\text{m}$  long) and *r3* (300  $\mu\text{m}$  long) are the stoutest. The setae of the opisthonotal region are mainly homogeneous, being curved and finely pilose (see inset to figure 42H). The tritosternum has a narrow base and pilose laciniae. The genital lamina protrudes from beneath the sternogenital shield. Sternal setae I–III narrow successively and, with setae IV, are finely pilose. The reticulated holovenral shield retains some of the deutosternal striations (Fig. 42I). The opisthogastric setae are fine and pointed. The postanal seta is approximately three times as long as the paranal setae and is stouter. Small circular granular areas are located at the approximate positions of the metapodal shields of the deutonymph. The peritreme extends to the level of coxa I.

The tectum is of irregular outline (Fig. 42J). The chelicera is shown in figure 42K, and the chaetotaxy of the palp trochanter, femur and genu in figure 42L. The corniculi are cleft on the inner margins and the gnathosomal setae are as in figure 42M. The chaetotaxy and armature of leg II are shown in figure 42N. The setae of leg I are strong but slender, many



**Fig. 42** *Parasitellus fucorum* (De Geer), **deutonymph** – A dorsum; B sternal shield; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G tarsus IV; **male** – H dorsum; I venter; J tectum; K chelicera; L palp trochanter, femur and genu; M venter of gnathosoma; N leg II.

having fine pilosity. Leg III has mainly strong curved setae with the genu and tibia each bearing a pair of stout ventral setae, whilst the tarsus bears stouter setae ventrally and laterally. The setae of leg IV are stouter towards the tibia and tarsus.



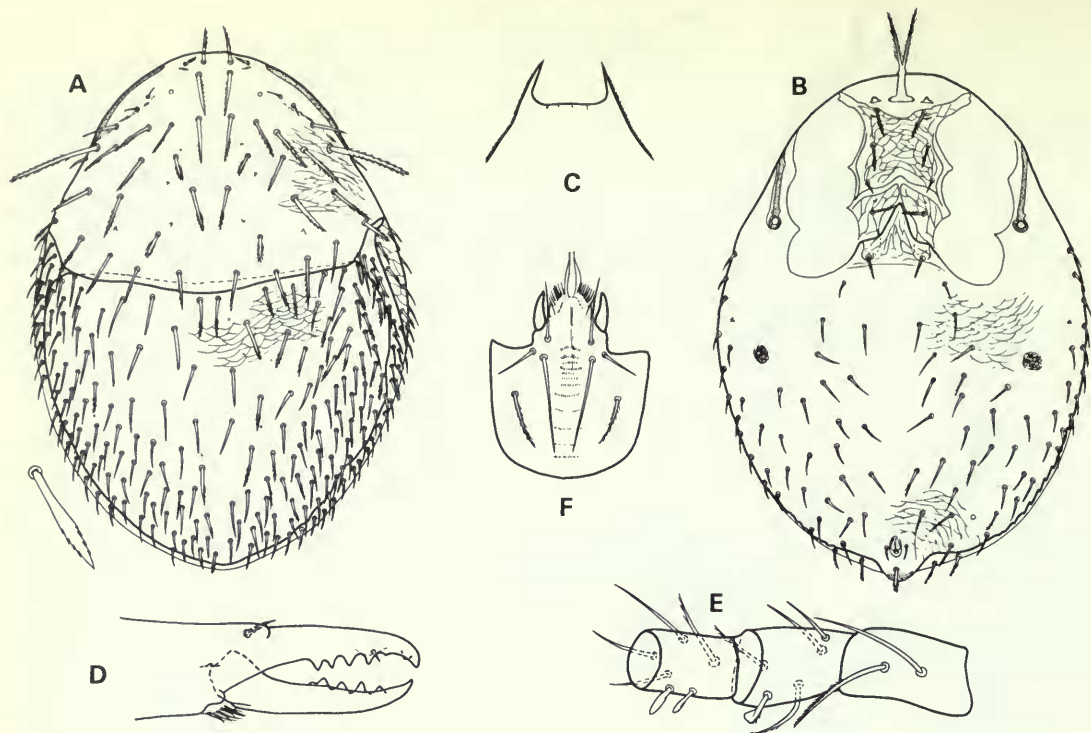


Fig. 43 *Parasitellus fucorum* (De Geer), female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

**FEMALE.** The idiosoma of the specimen figured measures  $1680\ \mu\text{m}$  long  $\times$   $1140\ \mu\text{m}$  wide, the podonotal shield being *c.*  $790\ \mu\text{m}$  long and the opisthonotal *c.*  $950\ \mu\text{m}$ , there being a small overlap. The podonotal shield is fused with the ventral sclerotization which extends to the dorsal surface at the widest point (Fig. 43A). The opisthonotal shield occupies almost the full width of the posterior region, being surrounded by a narrow area of membrane. The dorsal chaetotaxy differs from that of the male in that *j4* and *z5* are both considerably shorter (*c.*  $60\text{--}70\ \mu\text{m}$ ) than their adjacent setae, and all the setae are generally stouter (see inset to figure). Setae *r3* are *c.*  $300\ \mu\text{m}$ .

The tritosternum has a narrow base with a rather broader than usual 'foot' and has pilose laciniae. The presternal shields are small (Fig. 43B). The sternal, metasternal and genital shields are well sclerotized and reticulated and the setae are finely pilose. The opisthogastric region is entirely reticulated and the setae are mainly curved, with very fine pilosity. The paranal setae are short and the postanal is slightly longer, stouter and pilose. As in the male, circular granular areas are present at the metapodal positions. The peritreme extends to coxa I.

The tectum is quite unlike either the deutonymph or male. It comprises two widely spaced but converging slender tines, each finely denticulate on the outer margin (Fig. 43C). The cheliceral teeth are well developed and the digits are slender (Fig. 43D). The chaetotaxy of the palp trochanter, femur and genu is shown in figure 43E. The venter of the gnathosoma is as in figure 43F, the internal posterior hypostomatic setae being the longest. The setae on leg I are mainly fine and slender, but on legs II–IV they are considerably stouter and are largely pilose.

**MATERIAL EXAMINED.** 123 samples – 1180+DNN, 30 ♂♂, 39 ♀♀, plus three samples containing respectively 130, 170 and 275 deutonymphs of which a proportion were examined closely.

ENGLAND: Cornwall, Isles of Scilly, Devon, Somerset, Dorset, Gloucestershire, Hampshire, Surrey, Kent, Essex, London, Middlesex, Berkshire, Hertfordshire, Buckinghamshire, Oxfordshire, Norfolk, Huntingdonshire, Nottinghamshire, Derbyshire, Cheshire, Manchester, Lancashire, Cumberland, Northumberland, Yorkshire.

WALES: Caernarvonshire, Denbighshire.

SCOTLAND: Fifeshire, Orkney, Fair Isle, Shetland, Arran

IRELAND: Galway.

CHANNEL ISLANDS: Guernsey.

This common European species is almost certainly distributed throughout the British Isles. With few exceptions all the material examined is from *Bombus* spp. The exceptions are 12 samples from *Psithyrus* spp., three deutonymphs from *Otiorhynchus sulcatus* (Fabricius) (Coleoptera, Curculionidae) (the only Irish material examined), one deutonymph from *Chrysis ignita* (L.) (Hymenoptera, Chrysididae) from Berkshire, five samples from flowers, presumably visited by *Bombus*, and one sample of 26 deutonymphs on *Juniperus* sp. in Kent. Four of the total samples examined have no habitat data.

**DISTRIBUTION.** Surprisingly the only previous British records for this well-known species are from the Tyne Province (Hull, 1917 – *bombianus* and *nidicolens*, and Hull, 1918 – *fucarius*) and from Guernsey (Le Pelley, 1972). The specimens examined by Colombo (1961) from Surrey, Middlesex and Berkshire, have so far not been recorded. The inclusion by Micherdzinski (1969) of this species being recorded by Turk & Turk (1952) is erroneous. The records of *Parasitus bomborum* Oudemans, 1902*b*, by Stebbing (1965*a*, 1965*b*) cannot be taken as correct identifications and these specimens are not now available for examination (Stebbing, pers. comm.). Subsequent specimens collected by Stebbing from bumblebees in Essex, Hertfordshire and Huntingdonshire in 1969 represent all four species of *Parasitellus* and are incorporated into the relevant species records.

It is recorded from Swedish Lapland (Trägårdh, 1910), Holland (Oudemans, 1902*b*, 1906), France (Berlese, 1906, Schmölzer, 1956), Germany (Voigts & Oudemans, 1905, Willmann, 1939*b*, Karg, 1965, 1971, Holzmann, 1969), Switzerland (Schweizer, 1949, 1961), Italy (Berlese, 1906), Poland (Micherdzinski, 1969, Chmielewski, 1971), Greece (Oudemans, 1905*b*) and Western Siberia (Davydova, 1976).

*Parasitellus crinitus* (Oudemans) comb. nov.

(Figs 44 A–M; 45A–F)

*Parasitus crinitus* Oudemans, 1903*b*: 85; 1905*a*: 79. Berlese, 1906: 264. (Non Vitzthum, 1930*a*: 31 = *P. ignotus* Vitzthum, 1930*a*).

*Parasitus crinitosimilis* Vitzthum, 1930*a*: 33 (DN). Colombo, 1961. Micherdzinski, 1969: 608. (Non Holzmann, 1969: 55 = *P. talparum* (Oudemans, 1913*a*). Karg, 1971: 451. **Syn. nov.**

*Parasitus (Parasitus) crinitosimilis*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 74.

*Parasitus dubiosus* Vitzthum, 1930*a*: 37 (♀). Colombo, 1961. Micherdzinski, 1969: 601. Karg, 1971: 450. **Syn. nov.**

*Parasitus (Parasitus) dubiosus*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 74.

*Parasitus talparum* Oudemans, 1913*a* sensu Lundqvist & Micherdzinski, 1975: 71 (♀ only).

**DEUTONYMPH.** The podonotal shield averages 400 µm long × 430 µm wide, is entirely reticulated and bears 21 pairs of setae, several of which are sparsely pilose (Fig. 44A). The majority are long and the longest, *r*3 and *z*5, measure *c.* 230 µm and *c.* 180 µm respectively. The opisthonotal shield averages 252 µm long × 372 µm wide and bears up to about 40 pairs of slender simple setae, mainly arranged symmetrically, but with additional unpaired setae amongst the *J*-series.

The tritosternum, which has a narrow base and pilose laciniae, is flanked by a pair of small but conspicuous presternal shields (Fig. 44B). The sternal shield averages 275 µm long, is strongly reticulated and the four pairs of setae are long and slender, with *st.* I and II bearing sparse pilosity. The opisthogastric setae are fairly dense, several may be fused onto the edge of the ovoid reticulated anal shield. The paranal setae are shorter than the postanal and all three are more slender than the opisthogastric setae. The peritreme extends to coxa I.

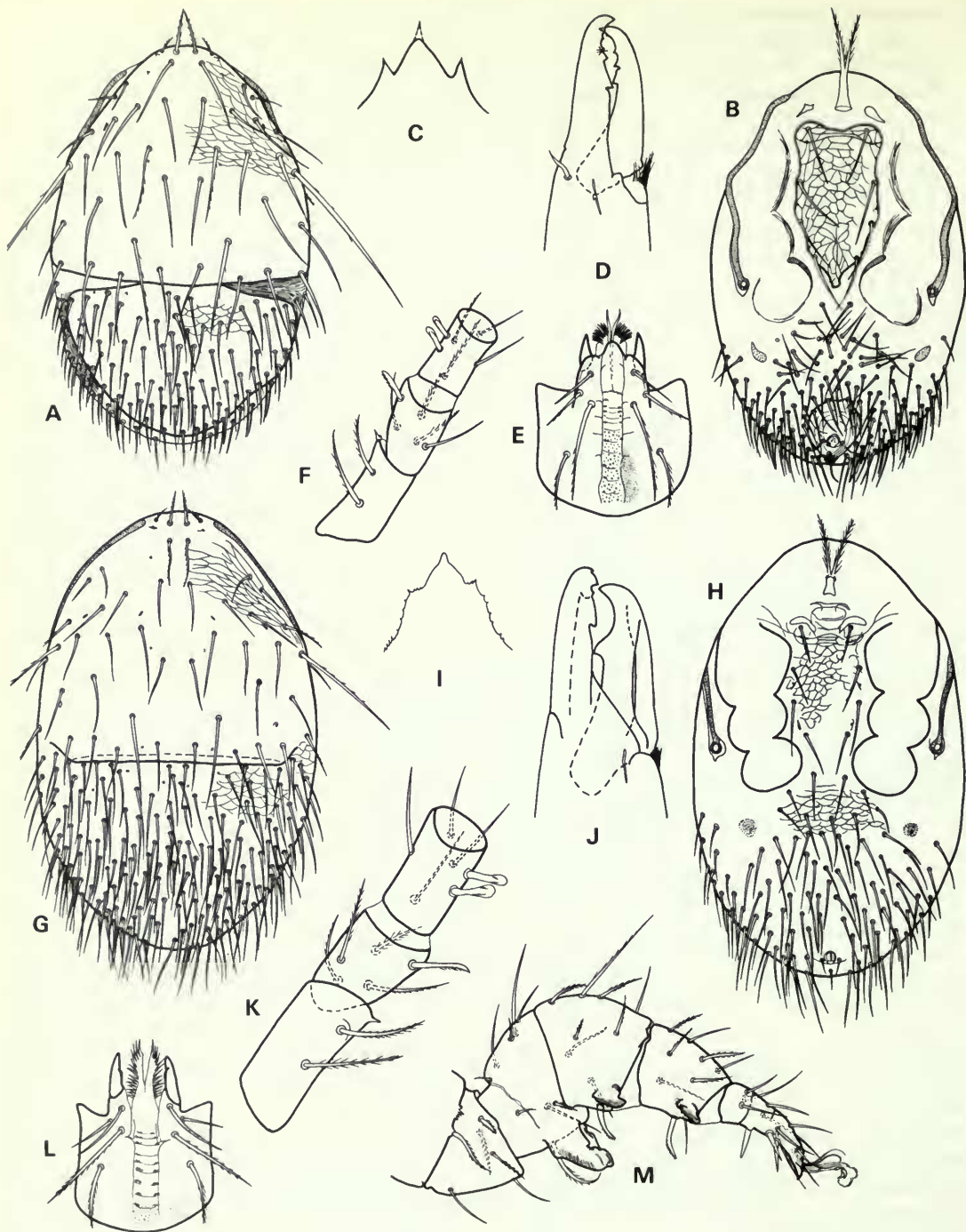


Fig. 44 *Parasitellus crinitus* (Oudemans), deutonymph - A dorsum; B venter; C tectum; D chelicera; E venter of gnathosoma; F palp trochanter, femur and genu: male - G dorsum; H venter; I tectum; J chelicera; K palp trochanter, femur and genu; L venter of gnathosoma; M leg II.



The tectum is trispinate: the centre portion is broad and tapers to a fine short point which may be broken off, whilst the two lateral spines are smaller and pointed (Fig. 44C). The chelicera is shown in figure 44D, the venter of the gnathosoma in figure 44E, and the palp trochanter, femur and genu in figure 44F. The setae on legs I and II are the finest and some are pilose; leg III bears stouter pilose setae, especially on the tarsus, and leg IV bears two long setae dorsally on the tarsus which measure *c.* 125  $\mu\text{m}$  and *c.* 175  $\mu\text{m}$  respectively.

**MALE.** The idiosoma (940–960  $\mu\text{m}$  long  $\times$  550–635  $\mu\text{m}$  wide) is strongly sclerotized and entirely reticulated (Fig. 44G). The podonotal region bears 23 pairs of setae of which the longest are *z5* (210  $\mu\text{m}$ ) and *r3* (275  $\mu\text{m}$ ). The opisthonotal setae are numerous and evenly distributed.

The tritosternum has a short, narrow, base and pilose laciniae. The presternal shields appear to be engulfed by the anterior reaches of the sternal sclerotization and the genital lamina is not very conspicuous (Fig. 44H). The holovenal shield is strongly reticulated. The sternal setae are slightly stouter than the longer opisthogastric setae and may be sparsely pilose. The three anal setae are shorter and subequal in length. The peritreme extends to coxa I.

The tectum comprises a broad tapered central region with serrated posterior margins (Fig. 44I). The chelicera is shown in figure 44J, the fixed digit extends slightly beyond the tip of the movable. The chaetotaxy of the palp trochanter, femur and genu is as in figure 44K, and the venter of the gnathosoma in figure 44L. The inner margins of the corniculi are slightly stepped. Leg II is shown in detail in figure 44M. Leg I bears mainly fine setae, but the trochanter and femur each bear dorsally one short stout seta and a second seta slightly less stout. Legs III and IV bear stouter setae, especially on the tibia and tarsus.

**FEMALE.** The podonotal shield measures, in the single specimen examined, 540  $\mu\text{m}$  long  $\times$  570  $\mu\text{m}$  wide. It is lightly reticulated in the anterior and lateral portions, and is finely granular all over (Fig. 45A). It bears 21 pairs of setae of which some show sparse pilosity. Only *z5* (*c.* 185  $\mu\text{m}$ ) and *r3* (*c.* 220  $\mu\text{m}$ ) are long. The opisthonotal shield is granular and entirely reticulated. It measures 490  $\mu\text{m}$  long  $\times$  530  $\mu\text{m}$  wide and bears about 45–50 pairs of fine slender setae. The posterior membrane bears similar setae.

The tritosternum is flanked by a pair of inconspicuous but granular presternal shields (Fig. 45B). The ventral shields are all granular and strongly reticulated. The sternal setae are the stoutest and, like the genitals, are finely pilose. The metasternal and opisthogastric setae are probably all simple, although about half the opisthogastrics, which are not entirely symmetrical in their arrangement, are missing. The postanal seta is slightly longer than the paranal. The peritreme extends to coxa I.

The tectum is shown in figure 45C: the centre prong is slightly divided at its tip and the lateral teeth are not symmetrical. The chelicera is as in figure 45D: the fixed digit bears minute teeth between the tip and the first main tooth. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 45E, and the venter of the gnathosoma in figure 45F. All legs bear mainly simple setae, those on leg I being the most slender. Leg II bears a stout ventral seta on the tarsus and tibia, plus two short downcurved distal spurs on the tarsus. Several setae are missing from both legs IV, but I believe no long setae are normally present on the tarsus.

**MATERIAL EXAMINED.** 8 samples – 9DNN, 2  $\sigma\sigma$ , 1  $\varphi$ .

ENGLAND: Surrey, London, Buckinghamshire, Norfolk, Huntingdonshire, Derbyshire and Lancashire.

All material was associated with *Bombus* spp. or their nests, with the exception of a single deutonymph from Wimbledon Common, southwest London, that was collected on a shrew *Sorex* sp.

**DISTRIBUTION.** Colombo (1961) examined specimens from Surrey, Middlesex and Buckinghamshire but these records have remained unpublished. Therefore *Parasitellus*

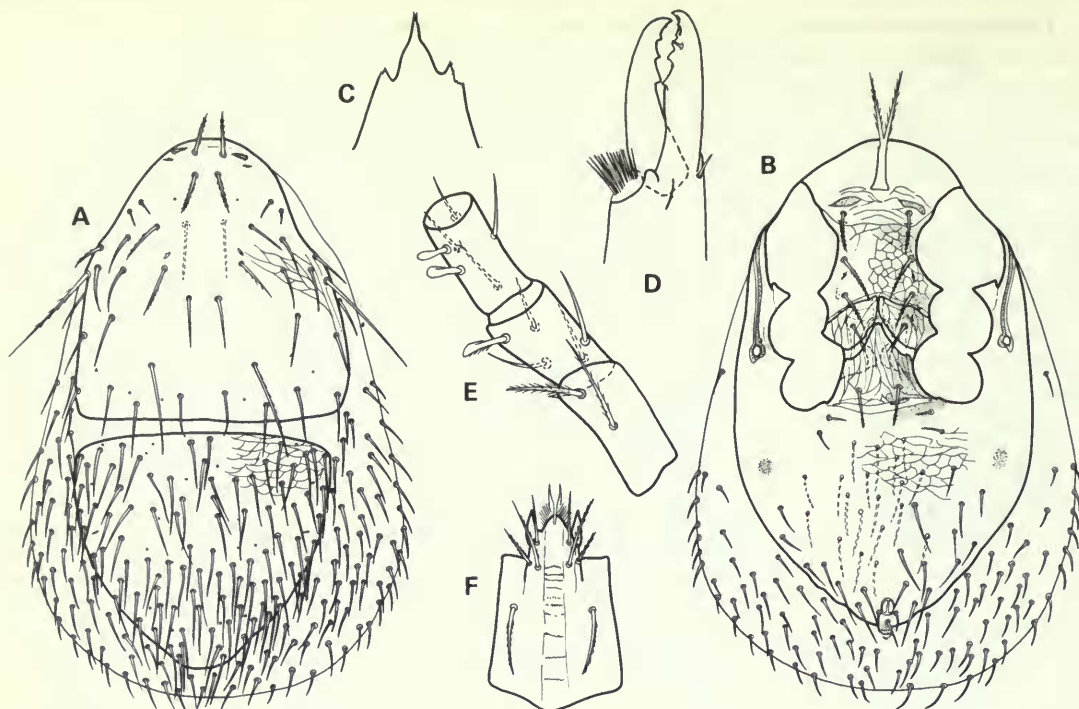


Fig. 45 *Parasitellus crinitus* (Oudemans), female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

*crinitus* is now recorded for the first time from the British Isles. Additionally it is only authentically recorded from Germany (Oudemans, 1905a, Willmann, 1939b, Vitzthum, 1930a).

***Parasitellus ignotus* (Vitzthum) comb. nov.**  
(Figs 46A–M; 47A–F)

*Parasitus ignotus* Vitzthum, 1930a: 40 (♀). Colombo, 1961. Micherdzinski, 1969: 531. Karg, 1971: 449.

*Parasitus (Parasitus) ignotus*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 72.

*Parasitus crinitus* Oudemans, 1903b *sensu* Vitzthum, 1930a: 31 (DN). Colombo, 1961. Micherdzinski, 1969: 608. Holzmann, 1969: 55. Karg, 1971: 451.

**DEUTONYMPH.** The podonotal shield (396–415  $\mu\text{m}$  long  $\times$  384–520  $\mu\text{m}$  wide) is well sclerotized and entirely reticulated (Fig. 46A). It bears 22 pairs of setae, most of which are rather long (*r3* are *c.* 205  $\mu\text{m}$ ) and well surpass the bases of the next posterior one. Some are finely pilose. The fine and slender *s1* and *s2* can be either on or off the shield and are included here as being on. An additional seta is located between *r5* and *s6*. The triangular opisthonotal shield (up to 280  $\mu\text{m}$  long  $\times$  390  $\mu\text{m}$  wide) is also entirely reticulated. It bears over 30 pairs of setae, those in the posterolateral region being shorter and more closely spaced than those situated medially. Additionally a cluster of up to five or six short setae are situated between *J1* and *J3*. The setae on the posterior interscutal membrane are numerous and appear as a continuation of those in the posterolateral area of the shield.

The tritosternum, which has a narrow base and pilose laciniae, is flanked by a pair of small rather irregularly shaped presternal shields (Fig. 46B). The sternal shield (280–336  $\mu\text{m}$  long) is entirely reticulated, but the area anterior to the first pair of pores is weakly sclerotized. The setae are long and slender. The opisthogastric region is densely pilose, the setae range from about 40–50  $\mu\text{m}$  in length. The anal shield is subcircular to oval and is reticulated. The

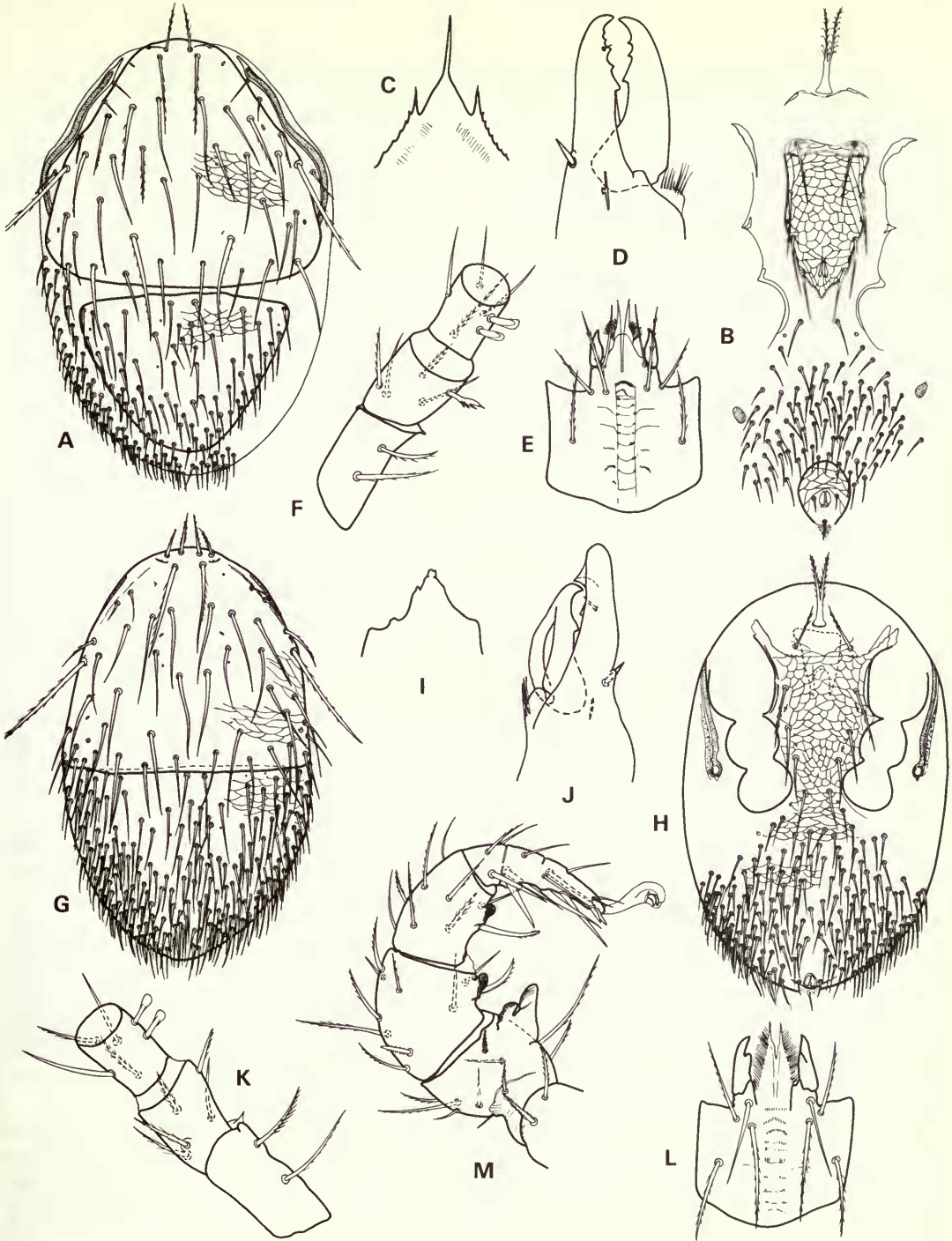


Fig. 46 *Parasitellus ignotus* (Vitzthum), **deutonymph** – A dorsum; B venter; C tectum; D chelicera; E venter of gnathosoma; F palp trochanter, femur and genu; **male** – G dorsum; H venter; I tectum; J chelicera; K palp trochanter, femur and genu; L venter of gnathosoma; M leg II.



postanal seta is slightly stouter and longer than the paranals. The peritreme extends to coxa I.

The tectum is trispinate (Fig. 46C). The centre prong has a broad base and tapers narrowly, the lateral spines are short and sharp with their basal edges toothed. The chelicera is shown in figure 46D, the venter of the gnathosoma in figure 46E, and the chaetotaxy of the palp trochanter, femur and genu in figure 46F. The setae on legs I and II are the finest and many are pilose. Leg III bears generally stouter setae which are almost all pilose, and dorsally on the femur is a conspicuous pilose seta distally. Leg IV has similar setae to leg III, but in addition the tarsus bears dorsally two conspicuously long setae measuring *c.* 240  $\mu\text{m}$  and 300  $\mu\text{m}$ .

MALE. The idiosoma averages 865–925  $\mu\text{m}$  long  $\times$  480–540  $\mu\text{m}$  wide and is entirely reticulated and with a transverse suture (Fig. 46G). The podonotal setae are mainly long and often sinuous with *r3* the longest (*c.* 200  $\mu\text{m}$ ). Most are finely pilose, but *s1* and *s2* are the shortest (*c.* 35  $\mu\text{m}$ ) and are very slender. The opisthonotal setae are numerous and densest in the posterolateral area where they are considerably shorter than those situated medially.

The tritosternum is present, but the presternal shields are absent. The holovenral region is well sclerotized and heavily reticulated (Fig. 46H). The sternogenital setae are the longest and the opisthogastric setae are dense. The postanal seta is slightly longer than the paranals and the peritreme extends to coxa I.

The tectum is presumably rarely of symmetrical appearance and a 'typical' example is shown in figure 46I. The fixed digit of the chelicera extends beyond a large terminal tooth below which the movable digit (98  $\mu\text{m}$ ) fits closely (Fig. 46J). The chaetotaxy of the palp trochanter, femur and genu is shown in figure 46K, and the venter of the gnathosoma in figure 46L. The corniculi are slender, notched internally and with the tips curved inwards. Leg II is shown in detail in figure 46M. The setae of leg I are mainly fine and simple. Tibiae III and IV each bear an erect seta dorsally and tarsus IV has two long dorsal setae measuring *c.* 212  $\mu\text{m}$  and 237  $\mu\text{m}$ .

FEMALE. The reticulated podonotal shield averages 505  $\mu\text{m}$  long  $\times$  610  $\mu\text{m}$  wide and is attenuated posterior to setae *r3* (Fig. 47A). It bears 23 pairs of setae, several of which are finely pilose. Setae *r3* are the longest (*c.* 250  $\mu\text{m}$ ) whilst *s1*, *s2* and *r4* are situated on the shield. The opisthonotal shield averages 515  $\mu\text{m}$  long  $\times$  490  $\mu\text{m}$  wide and fits closely against the podonotal. It bears about 50 pairs of rather long simple setae all of which surpass the bases of at least one succeeding seta. In some specimens a narrow strip of the interscutal membrane is sclerotized where it abuts the posterior region of the opisthonotal shield. This feature may also be encountered in the females of *P. talparum* (p. 337).

The tritosternum is flanked by a pair of small inconspicuous presternal shields (Fig. 47B). The sternal shield is heavily reticulated with an area of coarse granulation between setae III and the edge of the shield. Sternal setae I and II are slightly stouter than III, IV and the genital setae, and are more clearly slightly pilose. The genital shield is rounded, tapered anteriorly, and a small pair of conspicuous horns are situated laterally. The opisthogastric region is strongly reticulated and bears about 35 pairs of simple setae similar to the genital setae. The paranal setae are approximately half the length of the postanal. The opisthogastric shield is also bordered by a strip of sclerotized membrane. The peritreme extends to coxa I.

The tectum (Fig. 47C) is similar to that of the deutonymph. The chelicera is shown in figure 47D, the chaetotaxy of the palp trochanter, femur and genu in figure 47E, and the venter of the gnathosoma in figure 47F. The anterior hypostomatic setae appear to be the only pair that is simple. The corniculi are slightly undulating on their inner margins. All legs bear mainly pilose setae, those on leg I being the most slender. Tarsus IV bears two erect dorsal setae up to 250  $\mu\text{m}$  in length.

MATERIAL EXAMINED. 11 samples – 24 DNN, 4  $\sigma\sigma$ , 6  $\phi\phi$ .

ENGLAND: Surrey, Essex, Hertfordshire, Berkshire, Norfolk, Huntingdonshire and Lancashire.

IRELAND: Cork.

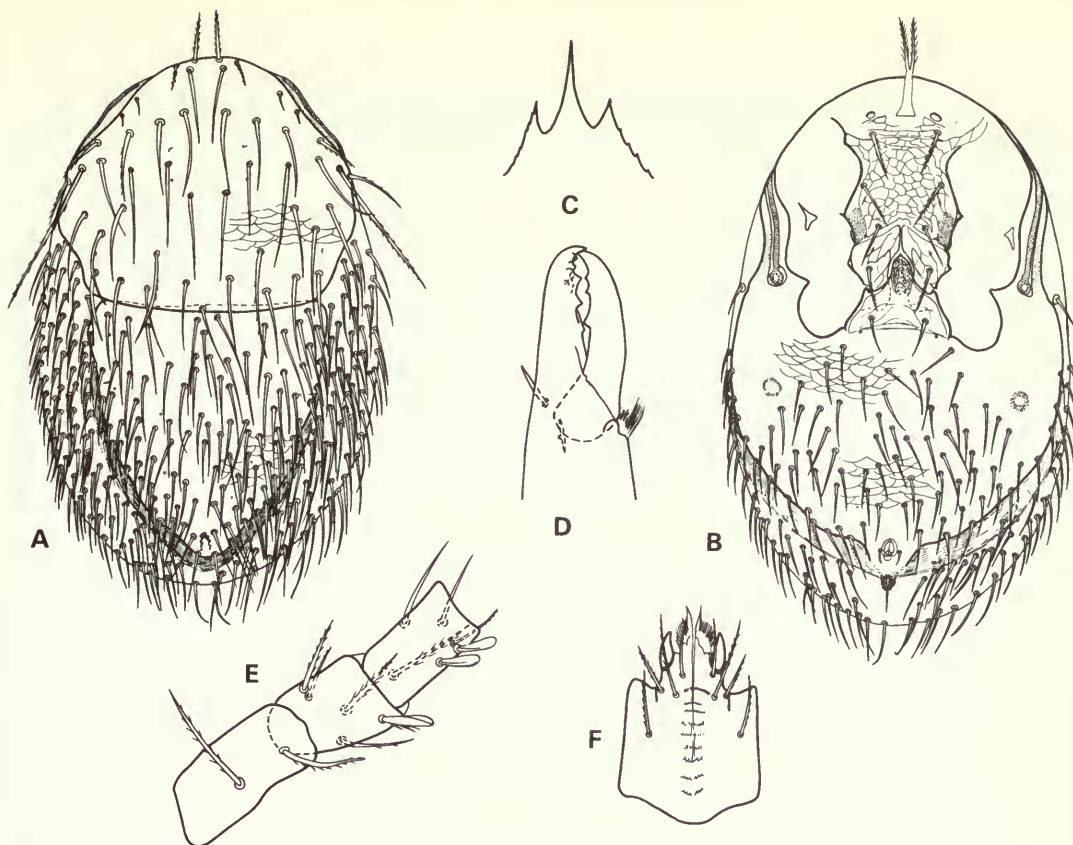


Fig. 47 *Parasitellus ignotus* (Vitzthum), female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

Ten of the samples were associated with *Bombus* spp. and their nests. The exception was five deutonymphs and three males from a nest of starling *Sturnus vulgaris* L. in the burrow of a sand martin *Riparia riparia* (L.) in Co. Cork, 3 June 1964. It is more than likely that bumblebees were also associated with the burrow.

**DISTRIBUTION.** Since Vitzthum's original description of presumably German material was published in 1930, the only other authentic record of this species appears to be that of Colombo (1961) who collected material in Surrey, Middlesex and Buckinghamshire. However, as these records are unpublished *Parasitellus ignotus* is now recorded for the first time from the British Isles.

***Parasitellus talparum* (Oudemans) comb. nov.**  
(Figs 48A–M; 49A–F)

*Parasitus talparum* Oudemans, 1913a: 333; 1914, Heft 8: 108. Turk & Turk, 1952: 477. Turk, 1953: 10. Micherdzinski, 1969: 605. Karg, 1971: 450. Lundqvist & Micherdzinski, 1975: 71 (DN only). Type examined.

*Parasitus (Parasitus) talparum*: Tichomirov, 1969: 1476.

*Parasitus bombophilus* Vitzthum, 1930a: 25 (DN, ♂). Karg, 1971: 449. Davydova, 1976: 61. **Syn. nov.**

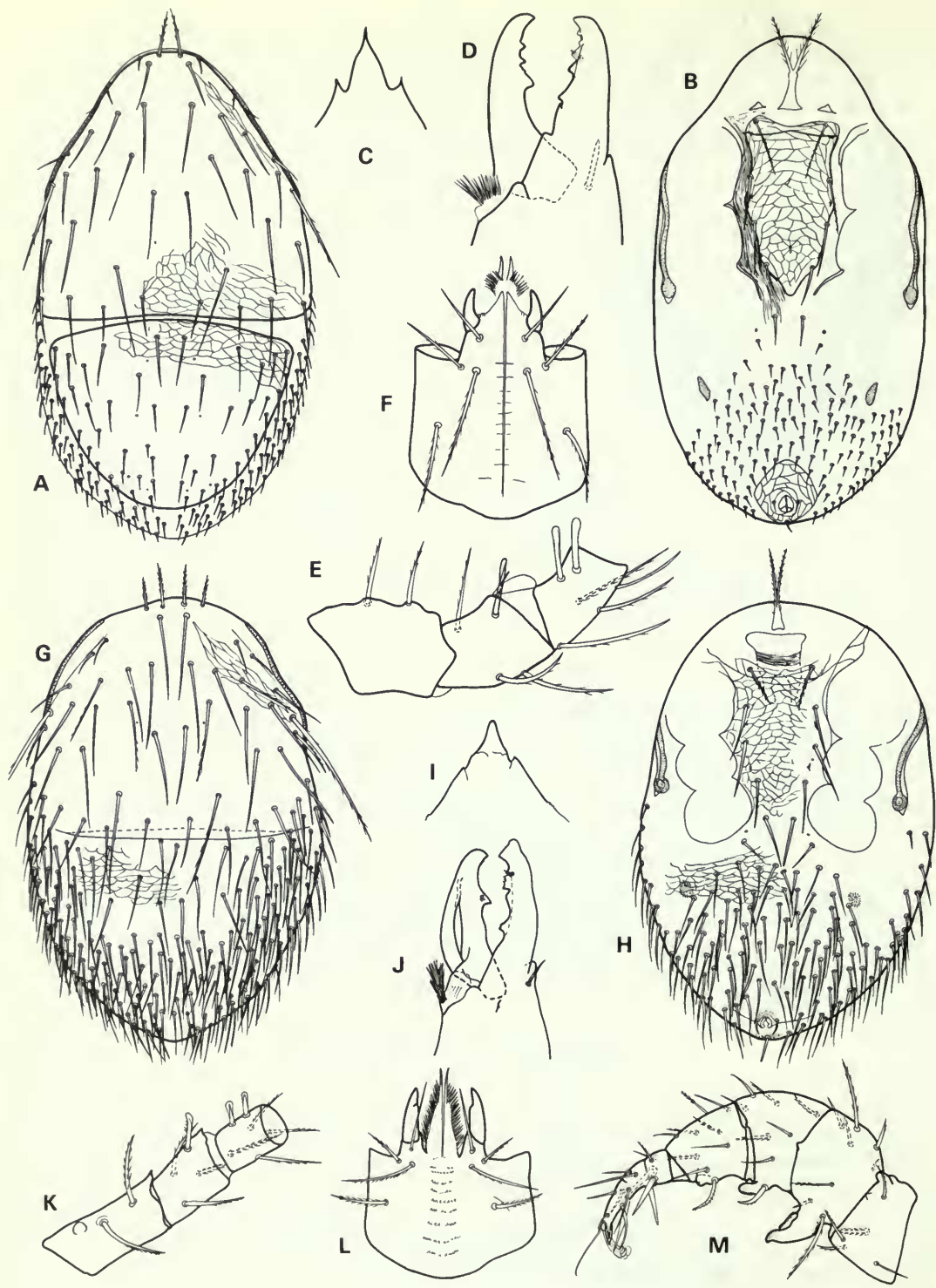
*Parasitus (Parasitus) bombophilus*: Tichomirov, 1969: 1476.

*Parasitus traegardhi* Micherdzinski, 1969: 567. Karg, 1971: 449.

*Parasitus (Parasitus) tragardhi*: Bregetova *et al.*, 1977: 74 (lapsus pro *traegardhi*).

*Parasitus bomborum* Oudemans sensu Trägårdh, 1904: 35.

*Parasitus fucorum* (De Geer) sensu Trägårdh, 1910: 384.





*Parasitus anglicus* Vitzthum, 1930a: 35 (DN). Micherdzinski, 1969: 608 (non *Gamasus anglicus* Hull, 1918 = *Parasitus loricatus* (Wankel)). **Syn. nov.**  
*Parasitus numismaticus* Vitzthum, 1930a: 42 (♀). Colombo, 1961. Micherdzinski, 1969: 433. Davydova, 1969: 23, 24, 26; 1976: 58. Holzmänn, 1969: 55. Karg, 1971: 449. **Syn. nov.**  
*Parasitus (Parasitus) numismaticus*: Tichomirov, 1969: 1476. Bregetova *et al.*, 1977: 72, 74.

Davydova (1976) records both *P. numismaticus* and *P. bombophilus*. Her figures labelled *numismaticus* (DN, ♂, ♀) are typical of the range I have encountered in *talparum*, whilst those labelled *bombophilus* (♂, ♀), although bearing rather short idiosomal setae, are still within the range.

**DEUTONYMPH.** The podonotal shield (420–525 µm long × 420–540 µm wide) is entirely reticulated and bears 21 pairs of setae, the longest being *z5* (c. 220 µm) and *r3* (c. 270 µm), the latter being sparsely pilose (Fig. 48A). Setae *j1* and *j2* are also usually pilose. The fine slender setae *s1* and *s2* can be either on or off the shield and are included here as being on. The opisthonotal shield (276–360 µm long × 360–480 µm wide) is also reticulated. It bears from 24 to 30 pairs of setae which are not always located symmetrically around the posterolateral margins. Anteriorly the setae are of similar length to the shorter podonotals, but posteriorly they resemble the dense interscutal setae which themselves become shorter posteriorly, ranging from 45–20 µm.

The tritosternum has a narrow base and pilose laciniae. It is flanked by small triangular presternal shields. The sternal shield (Fig. 48B) is clearly reticulated and measures 300–350 µm in length. The portion anterior to sternal pores I is often lighter coloured than the remainder. The setae are long and slender with fine pilosity on I and II. The reticulated anal shield is broadly oval, the three anal setae are of approximately equal length. The dense opisthogastric setae are longest anteriorly (c. 30 µm), becoming short posteriorly (c. 13 µm minimum). The metapodal shields are granular and the peritreme extends anteriorly to coxa I.

The tectum normally comprises a broad tapered tongue flanked by a pair of pointed teeth (Fig. 48C), but irregularities occur. The chelicera is shown in figure 48D. The chaetotaxy of the palp trochanter, femur and genu is as in figure 48E, and the venter of the gnathosoma in figure 48F. The corniculi are smoothly pointed and the internal posterior hypostomatic setae are the longest. The setae of leg I are slender. Leg II bears stout ventral setae on the tibia and tarsus. On legs III and IV the setae are generally stouter, especially on tibia and tarsus IV, whilst tarsus IV bears additionally two long dorsal setae (c. 370 µm) similar to *Parasitellus fucorum*.

**MALE.** The idiosoma measures 1150–1260 µm long × 780–840 µm wide. It is entirely reticulated and with a transverse suture (Fig. 48G). The majority of the setae are long, very slender and, apart from a few sparsely pilose pairs in the podonotal region, all are simple. Setae *z5* (c. 280 µm) and *r3* (330 µm) are the longest.

The tritosternum has a short narrow base and pilose laciniae. The genital lamina often protrudes from the sternogenital shield (Fig. 48H). The holovertral shield is reticulated. The slender sternal setae bear traces of pilosity, whereas the rather numerous opisthogastric setae are simple. Faint circular granular areas are present at the equivalent location of the metapodal shields of the deutonymph. The postanal seta is almost one and a half times as long as the paranals and is stouter. The peritreme extends to the level of coxa I.

The tectum is rather irregular in outline, but it comprises a triangular tongue with a pair of small lateral prongs (Fig. 48I). The chelicera is shown in figure 48J and the chaetotaxy of the palp trochanter, genu and tibia in figure 48K. The corniculi are slender, finely cleft on their inner margins, and the internal posterior hypostomatic setae are the longest (Fig. 48L). The chaetotaxy and armature of leg II are shown in figure 48M. The trochanter bears a small

**Fig. 48** *Parasitellus talparum* (Oudemans), **deutonymph** – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; **male** – G dorsum; H venter; I tectum; J chelicera; K palp trochanter, femur and genu; L venter of gnathosoma; M leg II.

conspicuous anteriorly directed domed or pointed spur dorsally. The setae on leg I are the most slender, many are finely pilose. Legs III and IV have stouter setae and tarsus IV bears two long dorsal setae (c. 359  $\mu\text{m}$ ) as in the deutonymph.

**FEMALE.** The podonotal shield measures 720  $\mu\text{m}$  long  $\times$  780  $\mu\text{m}$  wide. It is entirely reticulated and bears 23 pairs of setae (Fig. 49A), most of which are finely pilose to a certain extent with *z5* and *r3* the longest. The opisthonotal shield measures 720  $\mu\text{m}$  long  $\times$  756  $\mu\text{m}$  wide and is entirely reticulated. Occasionally a sclerotized strip of cuticle borders the shield, a feature which is frequently encountered in the Macrochelidae, but only rarely in other gamasines. About 40 pairs of setae are present, those anteriorly being the longest and resembling those of the podonotal shield, whilst posteriorly they become progressively shorter to about 30  $\mu\text{m}$ . The surrounding membrane is well clothed with setae laterally, becoming more sparse posteriorly.

The tritosternum has a narrow base and pilose laciniae. The presternal shields are coalesced to form a narrow strip (Fig. 49B). The sternal shield is strongly reticulated posterior to pore I, whilst adjacent to setae III lies a pair of circular granular areas. The metasternal and genital shields are weakly reticulated. The sternogenital setae are strongly formed and finely pilose. The opisthogastric shield is finely reticulated except for an area posterior to coxae IV which is ornamented with heavy crenate reticulations. In some specimens the posterior margin is bordered by a sclerotized strip of cuticle. About sixteen setae in the centre of the opisthogastric shield are conspicuously long and finely pilose, whereas the remainder are short and fine. The paranal setae are also short and fine, but the postanal is longer, stouter and pilose. As in the male, circular granular areas are present at the metapodal positions. The peritreme extends to coxa I.

The tectum is shown in figure 49C, the chelicera in figure 49D, the chaetotaxy of the palp trochanter, femur and genu in figure 49E, and the venter of the gnathosoma in figure 49F: the internal posterior hypostomatic setae are the longest. The setae on leg I are mainly fine and slender. On leg II the genu, tibia and tarsus each bear a single stout seta ventrally. Leg III bears ventrally on the genu and tibia a pair of stout setae and on the tarsus a single one. Leg IV bears generally stouter setae, especially on the tibia and tarsus.

**MATERIAL EXAMINED.** 30 samples – 83 DNN, 16  $\sigma\sigma$ , 16  $\phi\phi$ .

ENGLAND: Devon, Hampshire, Gloucestershire, Oxfordshire, Berkshire, Middlesex, Essex, Norfolk, Huntingdonshire, Lancashire, Cheshire.

SCOTLAND: Edinburgh district, Outer Hebrides (Isle of Lewis).

IRELAND: Dublin.

Most of the material examined is from bumblebees of the genus *Bombus*, but two single deutonymphs are from *Apodemus sylvaticus* (L.) and two are from flower-heads.

**DISTRIBUTION.** The only previous records of this species from the British Isles are by Vitzthum (1930a) who described *Parasitus anglicus* from two deutonymphs collected by O. W. Richards on *Bombus lapidarius* (L.) at Oxford. Turk & Turk (1952) identified two deutonymphs from the nest of *Apodemus sylvaticus* (L.) at North Bull, Dublin as *Parasitus talparum* Oudemans. I have examined one of the Dublin specimens and agree with the designation. Colombo (1961) examined *numismaticus* from Surrey, Middlesex and Buckinghamshire, but these records have until now remained unpublished.

This species is recorded from Greenland (Trägårdh, 1904), Swedish Lapland (Trägårdh, 1910), southern Sweden (Lundqvist, 1974, Lundqvist & Micherdzinski, 1975), Germany (Vitzthum, 1930a), Holland (Oudemans, 1913a, 1914), Switzerland (Schweizer, 1949, 1961), Czechoslovakia (Micherdzinski, 1969) and Western Siberia (Davydova, 1969, 1976).

#### Genus *GAMASODES* Oudemans

*Gamasodes* Oudemans, 1939. *Zool. Anz.* **126**: 24.

**TYPE SPECIES.** *Gamasoides spiniger* Oudemans, 1936 (= *Eugamasus spiniger* Trägårdh, 1910).

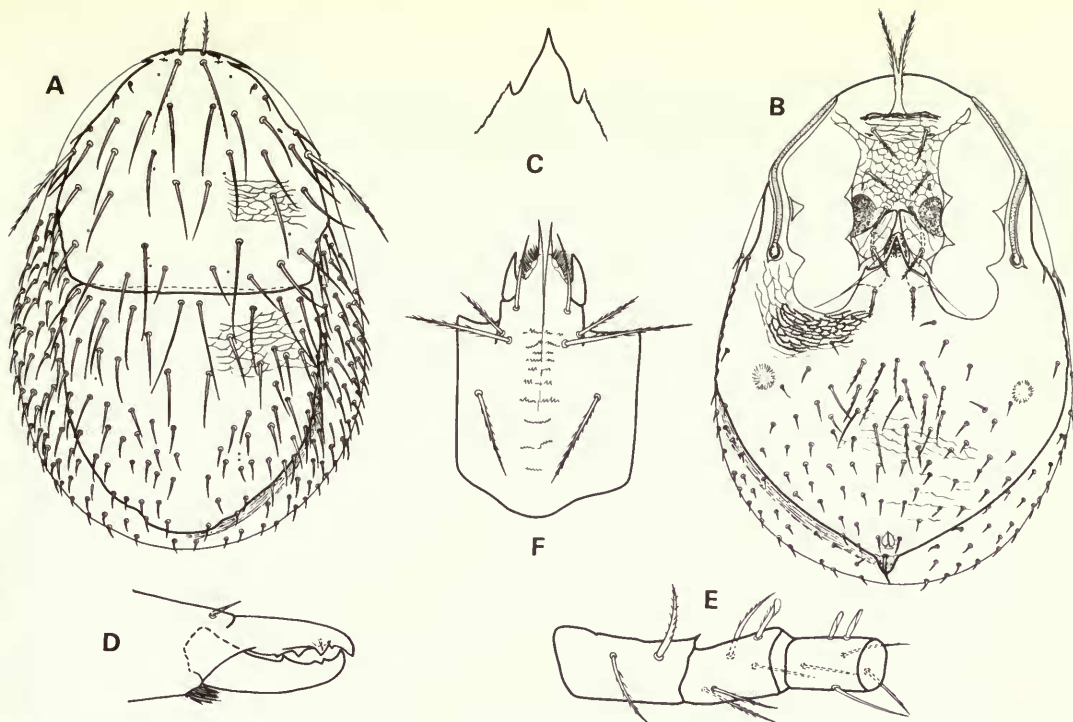


Fig. 49 *Parasitellus talparum* (Oudemans), female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields, or female with schizodorsal shield. Setae  $z5$  of dorsal hexagon differing in length and form from setae  $j5$  and  $j6$ , or if similar, then female with schizodorsal shield. Tritosternum of male absent or rudimentary, that of deutonymph and female normal, biramous. Junction between sternal and metasternal shields of female oblique. Genital shield of female subtriangular. Opisthogaster with rarely more than 18 pairs of setae. Seta  $al$  of palp femur setiform, with or without spicules; setae  $al_1$  and  $al_2$  of palp genu spatulate. Male chelicerae symmetrical. Corniculi entire, short, tapered. Leg II of deutonymph with strong slender spurs; leg II of female sometimes with spurs or modified setae; leg II of male spurred. Lobes of pulvilli normal, rounded.

***Gamasodes spiniger* (Trägårdh)**  
(Figs 50A–N; 51A–G)

*Gamasus spinipes* C. L. Koch, 1844, non Say, 1821, teste Oudemans, 1936: 202.

*Poecilochirus spinipes*: Berlese, 1892b: Fasc. 69, T. 4.

*Gamasoides spinipes*: Halbert, 1915: 55; 1920: 119, in part. Oudemans, 1939a: 24.

*Gamasoides spiniger* Oudemans, 1936: 202, *nom. nov. pro Gamasus spinipes* Koch.

*Gamasodes spiniger* Oudemans, 1936. Oudemans, 1939b: 199. Strenzke, 1951: 20. Schweizer, 1961: 11.

*Eugamasus spiniger* Trägårdh, 1910: 402.

*Gamosodes spiniger* (Trägårdh, 1910). Costa, 1961: 271. Micherdzinski, 1969: 616. Karg, 1971: 416.

Bregetova *et al.*, 1977: 94, 95. Evans & Till, 1979: 210.

*Parasitus lunarisimilis* Schweizer, 1961: 18. Micherdzinski, 1969: 550. Karg, 1971: 447. **Syn. nov.**

Type examined.

**DEUTONYMPH.** The podonotal shield (312–348  $\mu\text{m}$  long  $\times$  372–420  $\mu\text{m}$  wide) is strongly sclerotized and entirely reticulated. It bears 19 pairs of setae of which  $j1$  and  $r3$  are the



stoutest, longest and are pilose. The remaining setae are mainly finely pointed and simple, although sparse pilosity does occur on a few. Setae *s2* and *r2* are situated off the shield (Fig. 50A). The opisthonotal shield (204–240  $\mu\text{m}$  long  $\times$  324–384  $\mu\text{m}$  wide) is of similar structure to the podonotal and bears 14 pairs of setae of which three pairs, *J5*, *Z1* and *Z3* are generally stouter, longer, and pilose. As on the podonotal shield, other setae may possess sparse pilosity.

The tritosternum has a narrow base and pilose laciniae. It is situated slightly anterior to the presternal shields which are broad and almost meet medially. The sternal shield (198–216  $\mu\text{m}$  long) is of a characteristic outline, is strongly sclerotized, reticulated and partly punctate (Fig. 50B). The sternal and opisthogastric setae are fine and slender. The anal shield is reticulated and broadly oval, and the three anal setae are simple, the postanal being slightly shorter than the paranals. The peritreme extends to coxa I.

The tectum is trispinate and has dentate lateral margins (Fig. 50C). The chelicera is as in figure 50D. The chaetotaxy of the palp trochanter, genu and tibia is shown in figure 50E: the anterolateral seta on the genu is broad but simple, and the two anterolaterals on the tibia have the distal margin scalloped. The venter of the gnathosoma is as in figure 50F. Legs I, III and IV bear simple setae, those on leg I being the finest. Tarsus IV bears an erect pilose dorsal seta 90–100  $\mu\text{m}$  long. Leg II is shown in detail in figure 50G: the femur bears ventrally a strong erect thumblike spur with a recurved tip, the genu a shorter, more pointed spur, the tibia a rounded spur of intermediate size, and the tarsus bears basally a short conical spur and medially a long tapering spur lying along the segment.

**MALE.** The idiosoma is strongly sclerotized, reticulated and measures on average 750  $\mu\text{m}$  long  $\times$  510  $\mu\text{m}$  wide. The dorsum is divided by a median transverse suture and the two halves may overlap (Fig. 50H). The podonotal region bears about 22 pairs of setae. The majority are very short (up to 23  $\mu\text{m}$ ) and fine, but four pairs, *j1* (c. 40  $\mu\text{m}$ ), *j4*, *z5* and *r3* (all c. 50  $\mu\text{m}$ ) are stout and pilose. The opisthonotal region bears similar short fine setae, more numerous posteriorly, and four pairs of stout pilose setae up to c. 65  $\mu\text{m}$  in length. A fifth stout pair is situated on the posterior margin.

The tritosternum is apparently lacking and the genital lamina, which is flanked by granular presternal shields, fits closely into the concave anterior margin of the sternogenital shield (Fig. 50I). The sternogenital setae are simple. The opisthogastric region is strongly sclerotized and bears nine pairs of simple setae and one pair of broader pilose setae near to the anus. The three anal setae are short and simple. The peritreme extends to coxa I.

The tectum is trispinate and symmetrical (Fig. 50J). The chelicera is shown in figure 50K: the articulating membrane is provided with a long brushlike process. The chaetotaxy of the palp trochanter, femur and genu is as in figure 50L. The trochanter differs from that of the deutonymph in that the basal seta is considerably stouter. The venter of the gnathosoma is as in figure 50M: the anterior and internal posterior hypostomatic setae are stout. Legs I, III and IV bear short simple setae. Leg II is shown in detail in figure 50N: the femur bears a broad thumblike spur with a short domed auxiliary spur, the genu a tall domed spur, and the tibia a smooth fingertip-like spur.

**FEMALE.** The podonotal shield (390–410  $\mu\text{m}$  long  $\times$  490–550  $\mu\text{m}$  wide) bears 21 pairs of setae of type and arrangement as in the male (*j1*, c. 45  $\mu\text{m}$ , *r3* c. 90  $\mu\text{m}$ , *j4* and *z5* are intermediate), except that *r4* and *s6* are lacking (Fig. 51A). The opisthonotal shield (430  $\mu\text{m}$  long  $\times$  550–590  $\mu\text{m}$  wide) bears only three pairs of stout pilose setae (c. 65  $\mu\text{m}$  long) and the small setae are rather less numerous than in the male. Both shields are reticulated.

The tritosternum has a narrow base and pilose laciniae. As in the deutonymph, the granular presternal shields are broad and taper towards each other (Fig. 51B). The sternal shield is reticulated and granular, and setae II are the stoutest and III the finest. The metasternal and genital setae are simple. The genital shield is broad, shallow, and has a long tapered sinuate tip. Two conspicuous but small teeth are visible on the underside of the anterior region of the genital shield and the main components of the endogynium are as shown. The sclerotized opisthogastric region bears seven pairs of setae of which the pair

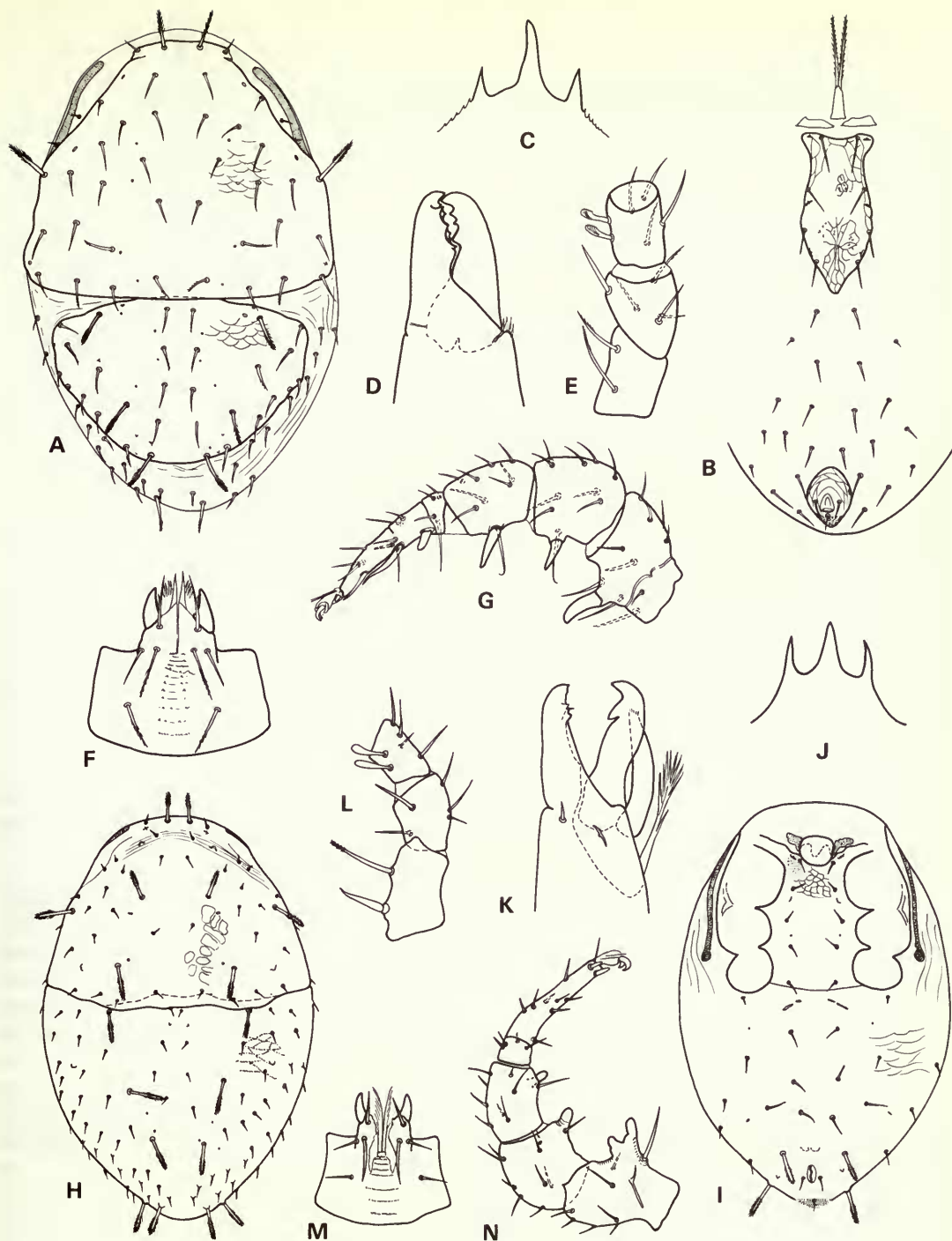


Fig. 50 *Gamasodes spiniger* (Trägårdh), deutonymph – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G leg II: male – H dorsum; I venter; J tectum; K chelicera; L palp trochanter, femur and genu; M venter of gnathosoma; N leg II.

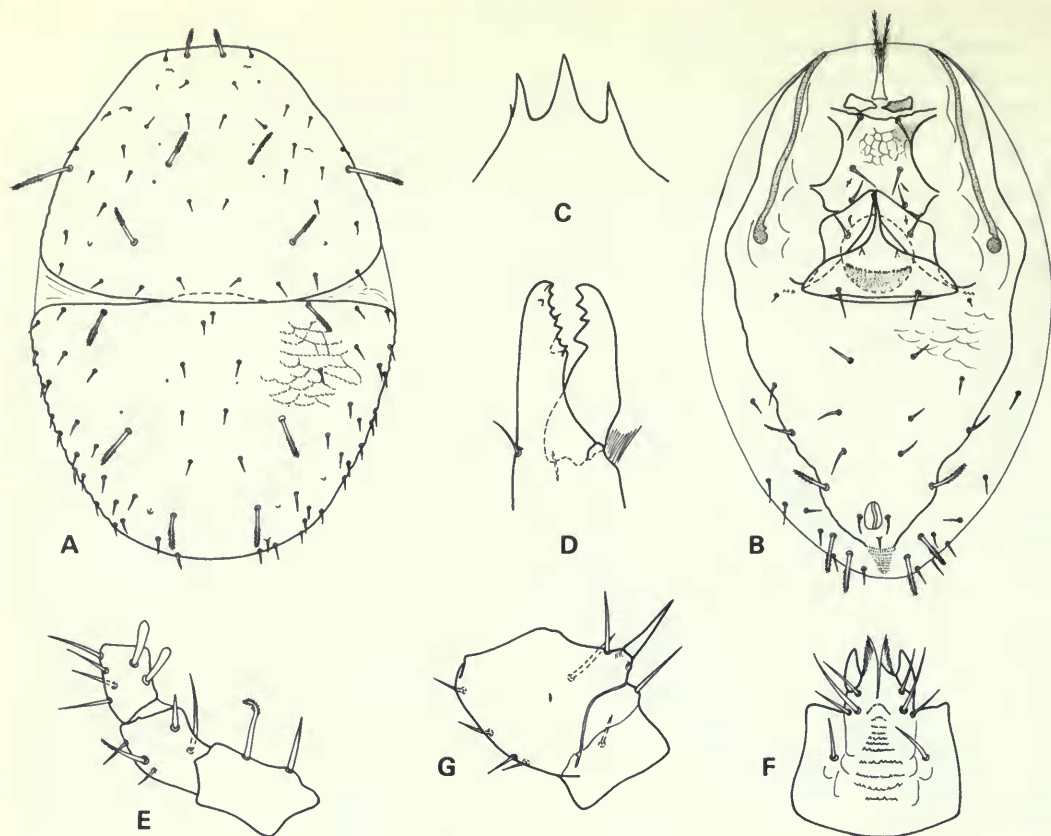


Fig. 51 *Gamasodes spiniger* (Trägårdh), female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G femur of leg II.

nearest the anus is stout and pilose, as are two further pairs on the adjacent membrane. The three anal setae are fine and short.

The tectum is trispinate similar to the male, slight variation has been observed (Fig. 51C). The chelicera is as in figure 51D. The movable digit has a large conical tooth and two smaller teeth, whilst the fixed digit bears six small teeth. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 51E, and the venter of the gnathosoma in figure 51F: the internal posterior hypostomatic setae are the broadest and the externals the shortest. Leg I bears fine simple setae. On leg II the setae are only scarcely stouter, but the femur bears ventrally a conspicuous stout tapered seta arising from a tubercle (Fig. 51G). Legs III and IV bear almost entirely fine short setae.

**MATERIAL EXAMINED.** 28 samples – 35 DNN, 1 ♂, 3 ♀♀.

ENGLAND: Somerset, Dorset, Isle of Wight, Hampshire, Surrey, London, Berkshire, Buckinghamshire, Essex, Cambridgeshire, Lincolnshire, Lancashire, Westmorland, Yorkshire.

WALES: North. No precise locality. See below.

SCOTLAND: Isle of Mull.

IRELAND: Kildare, Meath, Mayo.

In the British Isles this species has been found mainly in association with an animal 'host' such as birds, small mammals, including a fox corpse (Smith, 1975), and insects, but additionally in straw and grassland. A few only have been collected in leaf-litter and mosses. I have examined one deutonymph from seaweed. Previously identified specimens from this habitat have all proved to be *G. fimbriatus* Karg (p. 347).



**DISTRIBUTION.** Previous British records of this species are few. Halbert's (1915, 1920) specimens from old nests of puffins *Fratercula arctica* (L.) and black-backed gulls *Larus marinus* L. or *fuscus* L. on The Bills Rocks, Co. Mayo, 21 June 1910, belong to this species, whereas his specimens from under stones on the seashore, Bellacragher Bay, Mulranny, Co. Mayo, 25 September 1913, are *G. fimbriatus*. Hill & Gordon (1945) record deutonymphs of this species (as *Poecilochirus spinipes* Koch) from straw used to stuff the palliasses of American servicemen stationed in North Wales. I have examined some of these specimens. Block (1965) records *spiniger* from *Nardus stricta* L. grassland in Westmorland and I have examined these specimens. Turk (1967) records it from British caves without giving localities, though I have not examined any of his material, whilst Hazelton (1970*b*) records it from a well at Redbourne, Hertfordshire.

*Gamasodes spiniger* has been recorded from Sweden (Trägårdh, 1910), France (Cooreman, 1954), Belgium (van Daele & Heungens, 1974, 1975), Germany (Oudemans, 1936, Karg, 1961, 1965, 1971), Austria (Leitner, 1946), Switzerland (Schweizer, 1961), Italy (Valle, 1955), U.S.S.R. (Trägårdh, 1904, 1928), Western Siberia (Davydova, 1969, 1976), Poland (Micherdzinski, 1969) and Israel (Shulov, 1957, Costa, 1961, 1963, 1966), from habitats suggesting the various collections are correctly identified.

***Gamasodes bispinosus* (Halbert)**

(Fig. 52A–P)

*Gamasoides bispinosus* Halbert, 1915: 56.

*Gamasodes bispinosus*: Strenzke, 1951: 13. Holzmann, 1969: 30. Micherdzinski, 1969: 623. Karg, 1971: 416. Bregetova *et al.*, 1977: 94, 95.

**DEUTONYMPH.** The podonotal shield (310–320  $\mu\text{m}$  long  $\times$  355–360  $\mu\text{m}$  wide) is reticulated, bears 19 pairs of setae, *s2* and *r2* being off the shield (Fig. 52A). All setae are fine and slender except *j1* and *r3* which are stouter, sparsely pilose distally and approximately 28  $\mu\text{m}$  in length. The opisthonotal shield (180–200  $\mu\text{m}$  long  $\times$  300–310  $\mu\text{m}$  wide) is also reticulated and bears 12–13 pairs of simple setae. The setae on the posterior membrane are also simple.

The tritosternum has a narrow base and pilose laciniae. It is set close to the elongate presteranal shields (Fig. 52B). The sternal shield (198  $\mu\text{m}$  long) is symmetrically shaped and strongly reticulated. The setae are simple. The opisthogastric setae are also simple. The anal shield is reticulated, oval, the three setae are of approximately equal length and simple. The peritreme extends to coxa I.

The tectum comprises three widely spaced prongs, the centre one being forward of the lateral pair. The margin posterior to the lateral prongs is denticulate (Fig. 52C). The chelicera is as in figure 52D. The teeth are not so well separated as in either *spiniger* or *fimbriatus*. The chaetotaxy of the palp femur and genu is as in figure 52E, and the venter of the gnathosoma in figure 52F. Leg I bears fine simple setae. Leg II is shown in detail in figure 52G. The femur bears a forward-projecting thumblike ventral spur and at its inner angle is a second similar but smaller spur. The genu bears a single tapered peglike spur, whilst the tibia is devoid of spurs, but bears ventrally a stout seta. The tarsus bears proximally a peglike spur and medially a long tapering spur lying against the segment. Leg III bears simple setae which are stoutest on the tarsus, whilst leg IV bears similar setae with the addition of an erect pilose dorsal seta *c.* 65  $\mu\text{m}$  long on the tarsus.

**MALE AND FEMALE.** Adults have not been collected in the British Isles. Strenzke (1951) figured the deutonymph, male and female from specimens collected on the Baltic coast. Holzmann (1969) also figured both the adult sexes. Figures 52H–K of the male and 52L–P of the female are based on Strenzke's paper. The idiosoma of the male measures 750–850  $\mu\text{m}$  long  $\times$  500–550  $\mu\text{m}$  wide, and of the female 950  $\mu\text{m}$  long  $\times$  750  $\mu\text{m}$  wide.

**MATERIAL EXAMINED.** 4 samples – 5 DNN.

ENGLAND: One deutonymph on *Limosina* sp. (Diptera) in a garden, Madeley, Staffordshire, 25 April 1937, coll. H. Britten; one deutonymph in tidal debris at high water mark, Yantlet Creek, Allhallows, N. Kent, 29 July 1956, coll. K. H. Hyatt.

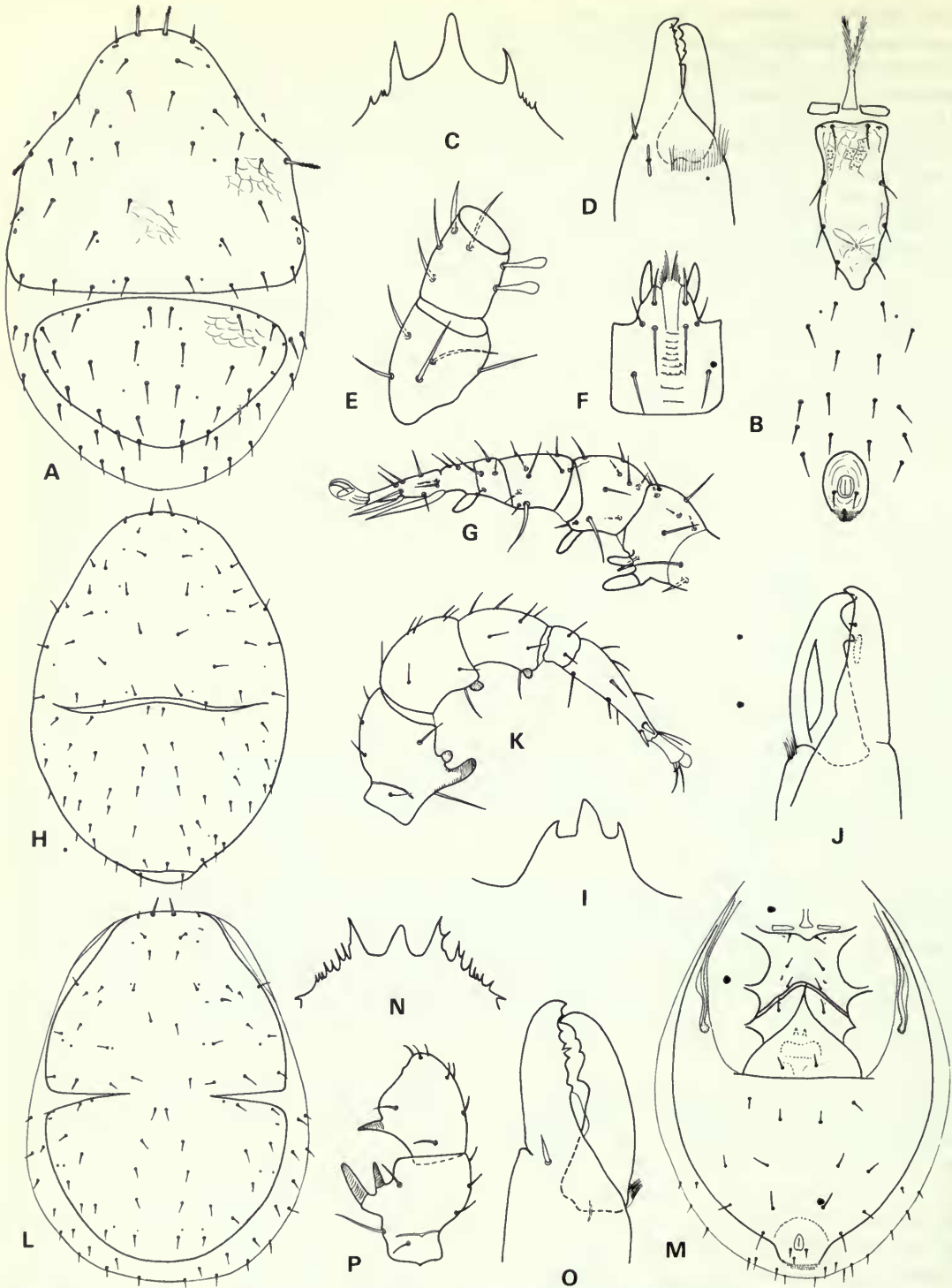


Fig. 52 *Gamasodes bispinosus* (Halbert), deutonymph—A dorsum; B venter; C tectum; D chelicera; E palp femur and genu; F venter of gnathosoma; G leg II: male—H dorsum; I tectum; J chelicera; K leg II: female—L dorsum; M venter; N tectum; O chelicera; P femur and genu of leg II. H–P after Strenzke, 1951.

WALES: Two deutonymphs in seaweed, Menai Straits, Bangor, Caernarvonshire, 23 August 1976, coll. Mrs M. J. Morgan.

IRELAND: One deutonymph from grassland, Celbridge, Co. Kildare, coll. G. O. Evans.

DISTRIBUTION. Halbert (1915) described this species from deutonymphs collected in moss near Lough Fenagh, Co. Mayo, and in moss from Poyntzpass, Co. Armagh, but since then there have been no British records.

It has been recorded from Germany (Strenzke, 1951, Holzmann, 1969, Karg, 1961, 1965, 1971), Austria (Franz, 1943, Strenzke, 1951), U.S.S.R. (Pinchuk, 1976) and Western Siberia (Davydova, 1969, 1976). Habitats range from the sea coast and in brackish habitats to rotting vegetation and humus in damp meadows and woods.

Davydova (1973) has described from Western Siberia a second species of *Gamasodes*, namely *G. micherdzinskii*, in which the deutonymph bears, like *bispinosus*, a double spur on femur II and the adults similar spurs. The main difference between the two species appears to be that *micherdzinskii* has considerably longer dorsal idiosomal setae than *bispinosus*.

***Gamasodes fimbriatus* Karg**  
(Figs 53A–K; 54A–F)

*Gamasodes fimbriatus* Karg, 1971: 414. Bregetova *et al.*, 1977: 94.

*Gamasoides spinipes* (C. L. Koch), Halbert, 1915: 55; 1920: 119, in part.

DEUTONYMPH. The podonotal shield averages  $324\ \mu\text{m}$  long  $\times$   $372\ \mu\text{m}$  wide and bears 19–21 pairs of setae (Fig. 53A). Setae *j1*, *j4*, *z5* and *r3* are stout and pilose, the remainder very short (max.  $20\ \mu\text{m}$ ) and simple but thornlike. Setae *s2* and *r2* may be on or off the shield. The opisthonotal shield averages  $216\ \mu\text{m}$  long  $\times$   $300\ \mu\text{m}$  wide and bears 14 pairs of setae of which three, *Z1*, *Z3* and *J5*, are pilose, stouter (*Z1* being the more so) and the remainder short and thornlike. Both shields are well sclerotized and entirely reticulated. The posterior membrane bears only short thornlike setae.

The tritosternum has a narrow base and pilose laciniae. It is set close to the presternal shields which almost meet medially (Fig. 53B). The sternal shield ( $228\ \mu\text{m}$  long) is symmetrically shaped, and the setae are slender and simple. The opisthogastric setae are short and two pairs in the anal region are pilose distally. The anal shield is oval and reticulated with the anus situated midway. The anal setae are fine and short. The peritreme extends to coxa I.

The tectum comprises a broad central pointed prong which is flanked by a backwards-sloping toothed ridge of apparently regular pattern (Fig. 53C). The chelicerae, which have one large and two smaller teeth on the movable digit and four or five well-separated teeth on the fixed, are similar to those of the female (Fig. 54D). The chaetotaxy of the palp trochanter, femur and genu, and also the venter of the gnathosoma, are as in the female (Figs 54E and F). The setae of leg I are mainly short and fine with few only pilose. Leg II is shown in detail in figure 53D. The ventral spur on the femur is slender, scarcely tapering and almost straight; that on the genu and tibia are similar but shorter, whilst the proximal spur on the tarsus is slightly tapering. Medially the tarsus bears a long tapering spur lying along the segment and distally two broad tapered ventral setae. Leg III bears stouter setae than leg I, especially on the tibia and tarsus, whilst on leg IV the setae are similar to those on leg III, but the tarsus bears an erect pilose dorsal seta  $85\text{--}90\ \mu\text{m}$  long.

MALE. The idiosoma is usually less heavily sclerotized than in *G. spiniger*. It measures  $804\text{--}850\ \mu\text{m}$  long  $\times$   $468\text{--}500\ \mu\text{m}$  wide and is divided dorsally by an undulating transverse suture (Fig. 53E). The podonotal region bears 23 pairs of setae, the majority of which are very short ( $25\ \mu\text{m}$  max.), but four pairs, *j1* (c.  $45\ \mu\text{m}$ ), *j4* (c.  $55\ \mu\text{m}$ ), *z5* (c.  $63\ \mu\text{m}$ ) and *r3* (c.  $75\ \mu\text{m}$ ), are stout and pilose. The opisthonotal region bears similar short setae with two pairs, *Z1* and *Z3*, stout, pilose and measuring approximately  $55\ \mu\text{m}$  in length.

The tritosternum is extremely small and is just visible beneath an anterior membrane protruding from the genital lamina (Fig. 53F). The presternal shields are indistinct. The



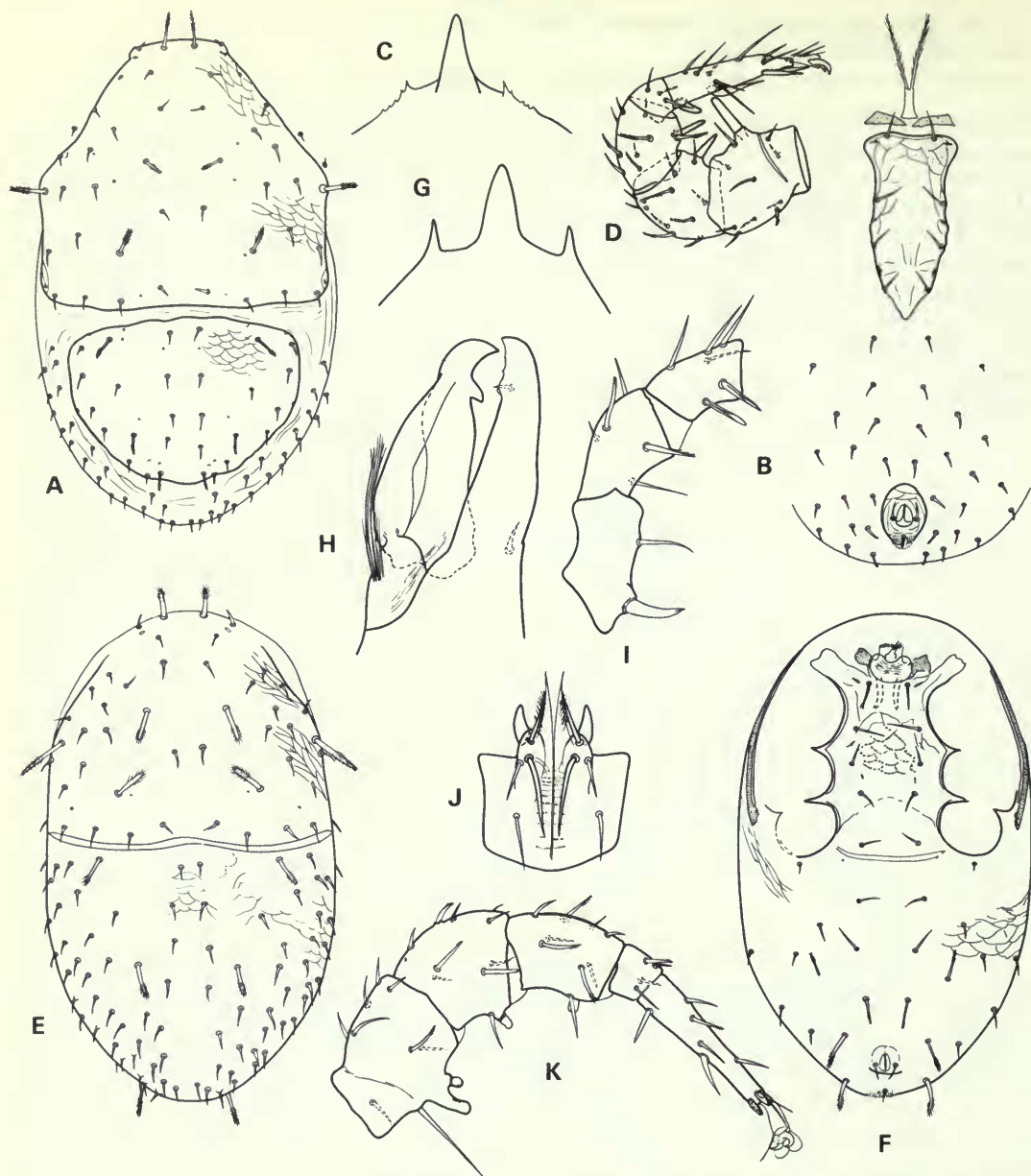


Fig. 53 *Gamasodes fimbriatus* Karg, **deutonymph**—A dorsum; B venter; C tectum; D leg II; **male**—E dorsum; F venter; G tectum; H chelicera; I palp trochanter, femur and genu; J venter of gnathosoma; K leg II.

sternal setae are fine, slender and in the specimen figured one seta I is bifid distally. Several of the opisthogastric setae are pilose distally and two posterior pairs are similar to the stout dorsal setae and measure *c.* 63  $\mu$ m. The anal setae are simple. The peritreme extends to coxa I.

The tectum has a broadly pointed centre prong and is flanked posteriorly by a pair of small short, pointed prongs (Fig. 53G). The chelicera is shown in figure 53H: as in *spiniger* the articulating membrane is provided with a long brushlike process. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 53I. the basal seta of the trochanter is much

stouter than in either the deutonymph or the female. The venter of the gnathosoma is shown in figure 53J. The anterior and internal posterior hypostomatic setae are stout with the latter being the longest. The setae of leg I are mainly simple although a number of the dorsal setae and some ventral are pilose in their distal thirds. Leg II is shown in detail in figure 53K. The femur bears ventrally a small thumblike spur with a domed tuberculated auxiliary spur, the genu bears a domed spur also arising from an eminence, and the tibia bears a fingertip-like spur only. The setae are relatively short, stout, and some are pectinate to one side of their tips. Legs III and IV bear short setae of which a number are pilose distally, often on one margin of the curved tip.

**FEMALE.** The podonotal shield (380–420  $\mu\text{m}$  long  $\times$  468–540  $\mu\text{m}$  wide) bears 21 pairs of setae whose arrangement and relative lengths are as in the male, except that  $r4$  are situated off the shield. Setae  $j1$  are *c.* 45  $\mu\text{m}$ ,  $j4$  *c.* 50  $\mu\text{m}$ ,  $z5$  *c.* 65  $\mu\text{m}$  and  $r3$  *c.* 75  $\mu\text{m}$ , and the right  $z6$  is duplicated (Fig. 54A). The opisthonotal shield (330–420  $\mu\text{m}$  long  $\times$  420–580  $\mu\text{m}$  wide) bears three pairs of stout pilose setae approximately 57  $\mu\text{m}$  in length, although in one of the specimens examined (Fig. 54A) an extra unpaired stout seta is present, and the remainder are simple, rather peglike, and vary in number (*cf.* Figs 54A and B).

The tritosternum has a narrow base and pilose laciniae. It is flanked by wedge-shaped granular presternal shields (Fig. 54C). The sternal shield is granular, setae I and II are the stoutest. The genital shield is broad, shallow, and has a long tapered tip. Two small teeth are visible on the underside of the anterior margin of the genital shield and the main components of the endogynium are shown. The sclerotized opisthogastric region bears seven pairs of setae of which the pair nearest the anus is stout and pilose, as are two further pairs on the adjacent membrane. The three anal setae are fine and short. The peritreme extends to coxa I.

The tectum is generally as in the male (Fig. 53G), only minor irregularities in outline having been observed. The chelicera is shown in figure 54D, the chaetotaxy of the palp trochanter, femur and genu in figure 54E, and the venter of the gnathosoma in figure 54F; the internal posterior rostral setae are the longest and stoutest. The setae of leg I are fine and simple. On leg II the setae are generally a little stouter, but the femur bears ventrally a stout tapered seta similar to that of *spiniger*. Legs III and IV bear stouter setae than *spiniger* and many have the distal portion finely pilose.

**MATERIAL EXAMINED.** 20 samples – 13 DNN, 21 ♂♂, 23 ♀♀.

ENGLAND: Isles of Scilly, Cornwall, Kent, Essex, Northumberland.

WALES: Caernarvonshire, Anglesey.

SCOTLAND: Argyllshire, Outer Hebrides (Harris, Lewis).

IRELAND: Clare, Mayo.

**DISTRIBUTION.** *Gamasodes fimbriatus* has not previously been recognized in the British literature and is recorded for the first time. Halbert's (1915, 1920) records of *Gamasoides spinipes* comprise two species, *Gamasodes spiniger* and *G. fimbriatus*. His specimens from old nests of seabirds are referable to *spiniger* (*q. v.*), but those from under stones on the seashore, Bellacragher Bay, Mulranny, Co. Mayo, 25 September 1913, are *fimbriatus*. The nineteen other samples examined here are from debris or under stones on the seashore.

Elsewhere this species is known only from the Baltic coast (Karg, 1971).

Genus **POECILOCHIRUS** G. & R. Canestrini

*Poecilochirus* G. & R. Canestrini, 1882. *I Gamasi Italiani. Monografia*. Padova: 21.

*Gamasoides* Berlese, 1904. *Redia* 1: 280.

**TYPE SPECIES.** *Poecilochirus carabi* G. & R. Canestrini, 1882.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields, although partial fusion may occur in some females. Setae  $z5$  of dorsal hexagon similar to setae  $j5$  and  $j6$  in females, considerably longer and/or stouter in deutonymphs and males. Tritosternum normal, biramous, that of male closely associated with genital orifice and with base shortened. Junction between sternal and

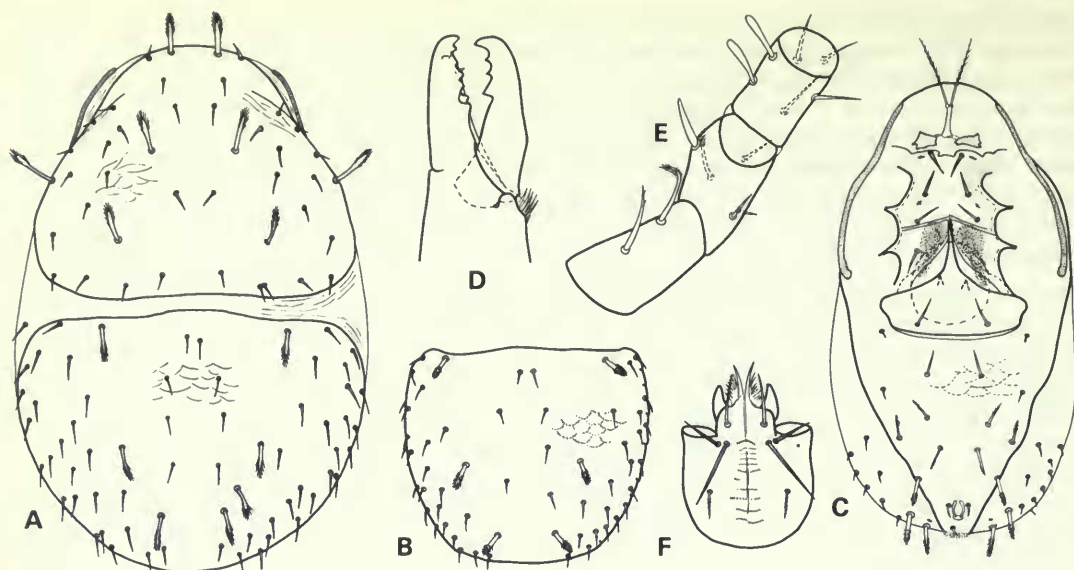


Fig. 54 *Gamasodes fimbriatus* Karg, female – A dorsum; B variation in opisthonotal shield; C venter; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

metasternal shields of female oblique. Genital shield of female triangular. Sternal shield of deutonymph usually showing transverse granular band between setae I and II. Opisthogastric shield in female with usually less than 15 pairs of setae; opisthogastric region in the male and deutonymph with considerably more. Setae  $al$  of palp femur and  $al_1$  and  $al_2$  of palp genu spatulate. Chelicerae of deutonymph sometimes with membraneous process at tip of fixed digit. Corniculi of male usually hooked, of female and deutonymph small and tapered. Legs of deutonymph and female normally without spurs; only leg II of male spurred. Lobes of pulvilli normal, rounded.

*Poecilochirus carabi* G. & R. Canestrini  
(Figs 55A–M; 56A–M)

*Poecilochirus Carabi* G. & R. Canestrini, 1882: 56. Vitzthum, 1930b: 392. Micherdzinski, 1969: 629. Holzmann, 1969: 7. Karg, 1971: 420. Bregetova et al., 1977: 99, 101, 102.

*Gamasoides carabi*: Halbert, 1915: 55.

*Poecilochirus necrophori* Vitzthum, 1930b: 392. Cooreman, 1943: 15. Neumann, 1943: 1–21. Turk & Turk, 1952: 480. Micherdzinski, 1969: 633. Holzmann, 1969: 7. Karg, 1971: 419. Bregetova et al., 1977: 99, 101. **Syn. nov.**

*Poecilochirus fucorum* (De Geer) sensu Berlese, 1892b, Fasc. 69, No.4, figs 1–4.

*Gamasoides eurasiatricus* Trägårdh, 1937: 8. Willmann, 1939a: 438. Micherdzinski, 1969: 633. Davydova, 1976: 103.

*Gamasus stygius* Hull, 1918: 85. Holzmann, 1969: 7. Micherdzinski, 1969: 629.

The deutonymphs of *Poecilochirus carabi* G. & R. Canestrini and *P. necrophori* Vitzthum fall into groups that are separated by most authors who have considered this genus (e.g. Vitzthum, 1930b, Micherdzinski, 1969 and Holzmann, 1969) on the single criterion of whether or not the transverse band in the anterior half of the sternal shield is produced up and down the margins of the shield. Karg (1971) separates the two species on their dorsal chaetotaxy and considers the emphasis on the sternal band to be a useless character. He also suggests that they may be subspecies. Vitzthum, around the time that he described *P. necrophori* (1930b), identified a single deutonymph in the British Museum collection from Bagley, Berkshire, as *P. carabi*. In this specimen the dark sternal band is at first glance without lateral extensions, but on closer examination, and by varying the intensity of the



illumination, these extensions are visible although paler than the central portion. The many British specimens examined, plus two large samples from France, show a wide degree of variation in both the extent and intensity of the sternal band, and in the dorsal chaetotaxy as enumerated by Karg. Therefore, in view of the wide range of variation encountered and the apparently arbitrary distinctions on which workers subsequent to Vitzthum have based their identifications, I feel disposed to consider *necrophori* to be a junior synonym of *carabi*.

Additionally, with both *Poecilochirus eurasiticus* Trägårdh, 1937 and *P. trebinjensis* Willmann, 1940 (which are not recorded from the British Isles) it seems that their status is based on equally variable characters as has been suggested already by Micherdzinski (1969) and they also may well be synonymous with *carabi*.

Trägårdh (1937) based his description of *eurasiaticus* on specimens from both Swedish Lapland and southern Mongolia, but his figures, especially of the dorsum, are lacking in detail and do not match his description, therefore without examining specimens it is not possible to pass judgment. However, Willmann (1939a) considers *eurasiaticus* to be synonymous with *necrophori*, whereas Micherdzinski (1969) considers only the Lapland specimens to be synonymous with *necrophori*. Davydova (1976) simply lists *eurasiaticus* as a synonym of *necrophori* without comment. Willmann (1940) based his description of *trebinjensis* on seven deutonymphs and a single male from Yugoslavia, and he noted that the nymphs closely resembled *necrophori* but were larger. Micherdzinski (1969) only commented that in spite of the wide geographical range of the deutonymphs of *Poecilochirus*-species, their differences were minute, and that the single specimen he had from Kashmir agreed with Willmann's description of *trebinjensis*. As both *eurasiaticus* and *trebinjensis* post-date *necrophori* their true status is of no direct consequence at present in relation to the British fauna, except to emphasize the need for detailed studies of their life histories to be carried out and for the range of variation within populations to be documented.

**PROTONYMPH.** Only one protonymph has been examined, but it compares favourably with the figures of Neumann (1943), Holzmänn (1969) and Micherdzinski (1969), who also figured the larva. Only Holzmänn, however, outlined the dorsal shields. Figures 55A–G show respectively the dorsum, the anal region, the tectum, the venter of the gnathosoma, the chelicera, the right palp trochanter, femur and genu, and the left tibia and tarsus IV.

**DEUTONYMPH.** The podonotal shield (576–670  $\mu\text{m}$  long  $\times$  720–930  $\mu\text{m}$  wide) is well sclerotized, granular and entirely reticulated (Fig. 55H). It bears 21 pairs of setae of which *z1*, *s1* and *s2* are very short (c. 14  $\mu\text{m}$ ) and peglike. The remaining setae are stout and of varying lengths with *z5* (c. 270  $\mu\text{m}$ ) and *r3* (c. 380  $\mu\text{m}$ ) the longest. The opisthonotal shield (420–480  $\mu\text{m}$  long  $\times$  720–860  $\mu\text{m}$  wide) is of similar texture to the podonotal shield. It bears 13 pairs of homogeneous setae of variable length which have traces of pilosity at their tips. The posterior membrane bears short setae.

The tritosternum has a narrow base and pilose laciniae. It is flanked by dark elongate presternal shields. The sternal shield (335–430  $\mu\text{m}$  long) is granular, reticulated, and has a transverse darkly sclerotized band between setae I and II, which may extend anteriorly or posteriorly by varying amounts and intensities (Fig. 55I). The endopodal shields are generally darkly sclerotized, especially at coxae IV. The opisthogastric setae are fine and simple. The anal shield is elliptical, reticulated and granular, and the paranal setae are slender, the postanal stouter. The peritreme extends to coxa I.

The tectum comprises a sharply tapered central prong flanked by a pair of inwardly curved side prongs (Fig. 55J). The chelicera is shown in figure 55K; the membranous process at the tip of the fixed digit is fairly constantly shaped but may be broken off. The chaetotaxy of the palp trochanter, femur and genu is as in figure 55L, with the anterolateral setae on the femur and genu alike, broadly spatulate distally, whilst the distal dorsal seta on the femur is noticeably stout and finely pilose in its distal half. The venter of the gnathosoma is shown in figure 55M. The corniculi are partly hidden by the hypostome. All leg setae are

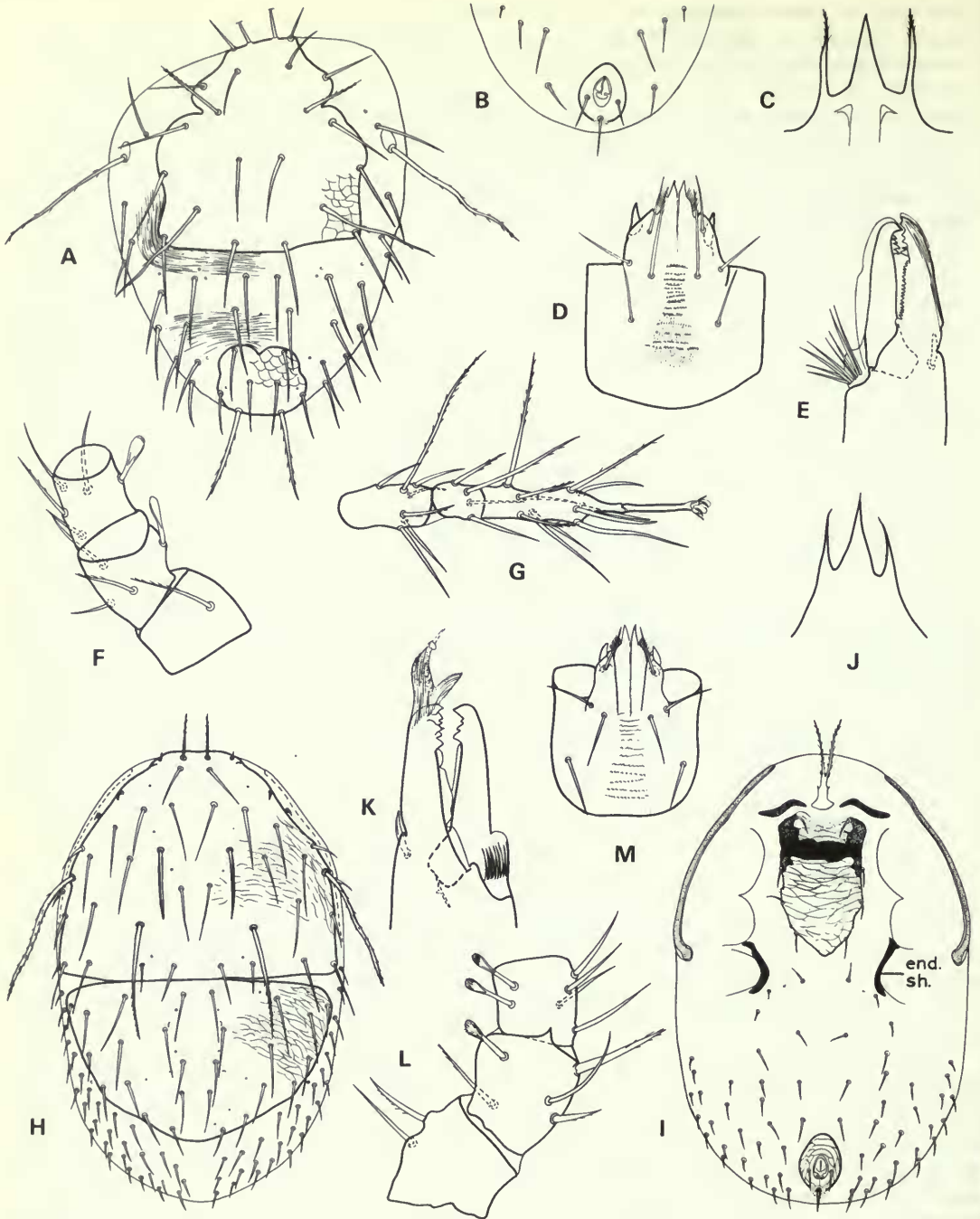


Fig. 55 *Poecilochirus carabi* G. & R. Canestrini, **protonymph**—A dorsum; B anal region; C tectum; D venter of gnathosoma; E chelicera; F palp trochanter, femur and genu; G tibia and tarsus of leg IV; **deutonymph**—H dorsum; I venter; J tectum; K chelicera; L palp trochanter, femur and genu; M venter of gnathosoma. *end. sh.*, endopodal shield.

strong and many are very finely pilose or rasp-like. Legs II–IV each bear an erect dorsal seta distally on the femur, that on femora III and IV being the longest (250  $\mu$ m and 350  $\mu$ m respectively).

**MALE.** The idiosoma is well sclerotized and entirely reticulated. It measures 1200–1300  $\mu\text{m}$  long  $\times$  780–840  $\mu\text{m}$  wide and is divided dorsally by a median transverse suture (Fig. 56A). The podonotal region bears 22 pairs of mainly stout and finely pilose setae of which three pairs, *j4*, *z5* and *r3*, are the longest. Setae *z1*, *s1* and *s2* are very short, *s1* being only c. 15–18  $\mu\text{m}$ . The opisthonotal region bears shorter stout pilose setae of more even length.

The tritosternum has a short narrow base and pilose laciniae (Fig. 56B). The venter is entirely covered by a reticulated holoventral shield. The sternal setae are the stoutest and longest, all are essentially simple, except the postanal which is long and finely pilose. The peritreme extends to coxa I.

The tectum comprises a broad denticulate process terminating in a long slender pointed tip (Fig. 56C). The chelicera is shown in figure 56D: the fixed digit lacks the membranous process at the tip. The chaetotaxy of the palp trochanter, femur and genu is as in figure 56E. The three anterolateral setae on the femur and genu are alike, the setae on the trochanter arise from strong tubercles. The venter of the gnathosoma is as in figure 56F. The corniculi are indented on their inner margins and the tips are hooked; the anterior hypostomatic setae are the stoutest and the external posteriors and the palpcoxals are finely pilose. Many of the leg setae are stout and/or finely pilose. Coxa I bears a short conical spurlike seta dorsally and the femur a similar but longer one. Leg II is shown in detail in figure 56G. Legs III and IV bear mainly stout but pointed setae with none conspicuously long.

**FEMALE.** The podonotal shield (700–750  $\mu\text{m}$  long  $\times$  880–1100  $\mu\text{m}$  wide) is well sclerotized and reticulated. It bears 21 pairs of setae all of which are stout, with the majority having at least the tips finely pilose or squarrose (Fig. 56H). Setae *j1* and *r3* are the longest and *z1*, *s1* and *s2* very short. The opisthonotal shield is of similar structure and measures 900–1020  $\mu\text{m}$  long  $\times$  1080–1390  $\mu\text{m}$  wide. The setae, which number about 40 pairs, are all of similar form to those on the podonotal shield, but slightly longer.

The tritosternum has a narrow base and pilose laciniae and is flanked by elongate curved presternal shields (Fig. 56I). The sternal and metasternal shields are generally rather indistinctly demarcated although well reticulated. Sternal setae II are the stoutest. The genital shield is pointed anteriorly but merges posteriorly with the opisthogastric shield. The opisthogastric setae are slender and simple. The anus is situated well in advance of the posterior margin of the often irregular opisthogastric shield which may be indented laterally. The paranal setae are short, fine, and the postanal stouter and long. The peritreme extends to coxa I.

The tectum is shown in figure 56J. It comprises a long tapered eminence with angular serrated margins. The chelicera is as in figure 56K, with additionally the tip of the second fixed digit of the same specimen. The fixed digit lacks the membranous process at the tip. The chaetotaxy of the palp trochanter, femur and genu is as in figure 56L. The three anterolateral setae on the femur and genu are alike. The venter of the gnathosoma is shown in figure 56M. Except for fine setae only on tarsus I, the majority of the leg setae are stout and finely pilose distally. No long setae are present.

**MATERIAL EXAMINED.** 162 samples – 1 PN, c. 3130 DNN, 5  $\sigma\sigma$ , 19  $\varphi\varphi$ .

ENGLAND: Cornwall, Somerset, Gloucestershire, Hampshire, Surrey, Sussex, Buckinghamshire, Berkshire, Hertfordshire, Bedfordshire, Suffolk, Norfolk, Lincolnshire, Shropshire, Derbyshire, Cheshire, Lancashire, Westmorland, Yorkshire, Northumberland (Farne Islands), Durham.

WALES: Glamorganshire, Pembrokeshire, Skomer, Cardiganshire, Montgomeryshire, Caernarvonshire.

SCOTLAND: West Lothian, Dunbartonshire, Perthshire, Arran, Outer Hebrides (Barra), Fair Isle.

IRELAND: Kerry (Great Blasket), two deutonymphs with no locality.

This species has been found in the British Isles, mainly in the deutonymph stage, almost



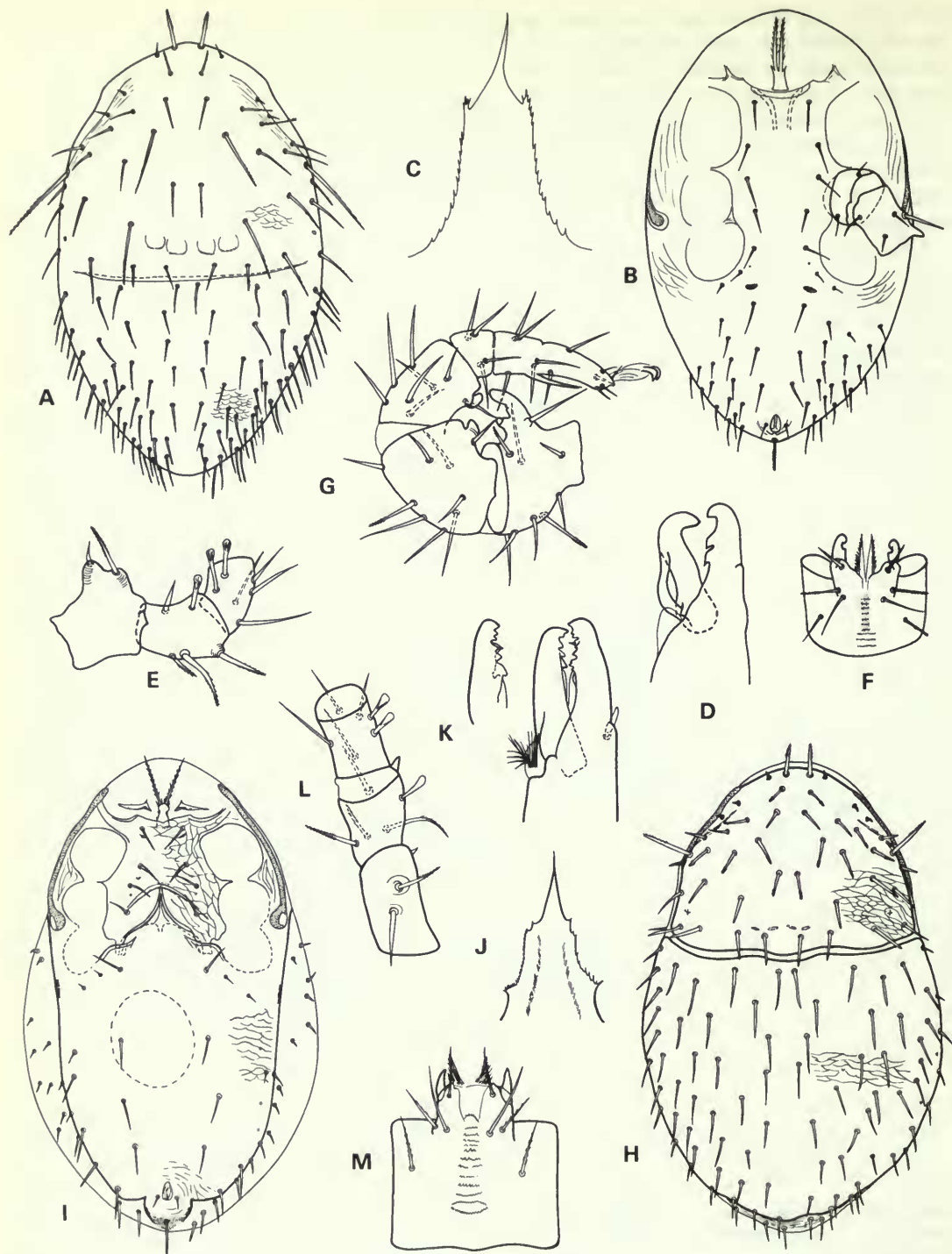


Fig. 56 *Poecilochirus carabi* G. & R. Canestrini, **male**—A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G leg II; **female**—H dorsum; I venter; J tectum; K chelicera, with additionally the second fixed digit of the same specimen; L palp trochanter, femur and genu; M venter of gnathosoma.

exclusively on carrion beetles of the genus *Nicrophorus* (Silphidae). A small number of samples are from beetles of other genera, viz. *Aphodius* (Scarabaeidae), *Carabus* and *Pterostichus* (Carabidae), whilst a few are from dead birds and small mammals. One specimen of *Nicrophorus humator* (Gleditsch) from North Hill, Launceston, Cornwall, 26 July 1974, was carrying 1486 deutonymphs of this species, together with 107 deutonymphs of *P. subterraneus*, 11 females of *Macrocheles glaber* (Müller) (Macrochelidae) and three females of *Alliphis halleri* (G. & R. Canestrini) (Eviphididae). The few adults examined are from red squirrel *Sciurus vulgaris* L., a dead mole *Talpa europaea* L., field-voles *Microtus agrestis* (L.) and a common shrew *Sorex araneus* L.

**DISTRIBUTION.** Previous British records are from the Tyne Province (Hull, 1918), Clare Island, Co. Mayo (Halbert, 1915), Isle of Lewis, Outer Hebrides (Hora, 1934), Cheshire, Lancashire, Cornwall and Ireland (no precise locality, but the same material as that quoted above for Ireland (Turk & Turk, 1952), and the Farne Islands (Springett, 1968). I cannot confirm the record from the Spurn Peninsula, Yorkshire (Braham & Murgatroyd, 1953).

*Poecilochirus carabi* is recorded from Belgium (Willmann, 1935, Leruth, 1939, Cooreman, 1943, van Daele & Heungens, 1974), Germany (Kneissl, 1914, Neumann, 1943, Holzmann, 1969, Karg, 1971), Switzerland (Schweizer, 1961), Italy (Schweizer, 1961), Poland (Willmann, 1939a, Starzyk, 1967), Romania (Cooreman, 1951), Czechoslovakia (Willmann, 1954, 1956, Mrciak & Rosický, 1956), Lapland (Trägårdh, 1937), U.S.S.R. (Bregetova, 1956, Vysockaja & Bregetova, 1957, Belozero, 1957, Rudysyn & Bilokon, 1961, Pirjanik, 1962, Pinchuk, 1976), Western Siberia (Davydova, 1969, 1976) and China (Vitzthum, 1930b).

### ***Poecilochirus austroasiaticus* Vitzthum**

(Figs 57A–F; 58A–G; 59A–F)

*Poecilochirus austroasiaticus* Vitzthum, 1930b: 392. Willmann, 1939a: 438. Holzmann, 1969: 7.

Micherdzinski, 1969: 665. Karg, 1971: 419. Bregetova *et al.*, 1977: 99, 101, 102.

*Poecilochirus nordi* Davydova, 1969: 29; 1976: 109. Bregetova *et al.*, 1977: 101, 102. **Syn. nov.**

**DEUTONYMPH.** The podonotal shield (432–460  $\mu\text{m}$  long  $\times$  480–492  $\mu\text{m}$  wide) is well sclerotized and entirely reticulated (Fig. 57A). It bears 21 pairs of setae, all are stout and relatively long with the following exceptions: *z1* very short and *s1*, *s2* and *r2* short but increasing in length progressively; *r3* the longest (c. 185  $\mu\text{m}$ ) and clearly but sparsely pilose, *z5* almost as long. Several other setae may also be pilose at their tips. The opisthonotal shield (276–330  $\mu\text{m}$  long  $\times$  400–456  $\mu\text{m}$  wide) is of similar texture to the podonotal shield. It bears 13 pairs of homogeneous setae with traces of pilosity at their tips. The posterior membrane bears shorter simple setae.

The tritosternum has a narrow base and pilose laciniae. It is flanked by dark elongate presternal shields (Fig. 57B). The sternal shield (264–280  $\mu\text{m}$  long) is granular, reticulated, and has a transverse darkly sclerotized band between setae I and II, which may extend anteriorly and posteriorly by varying amounts and intensities. The sternal setae are fine and slender. The endopodal shields at coxae IV are conspicuous and strongly sclerotized. The opisthogastric setae are fine and simple. The anal shield is elliptical, reticulated anteriorly, and the anal setae are simple, the postanal being the longest. The peritreme extends to coxa I.

The tectum comprises three slender pointed prongs, the lateral pair curving inwards (Fig. 57C). The chelicera is shown in figure 57D: only a rudimentary membranous process is present at the tip of the fixed digit. The chaetotaxy of the palp trochanter, femur and genu is as in figure 57E: the anterolateral setae on the femur and genu are alike. The venter of the gnathosoma is as in figure 57F. The corniculi are partly concealed by the anterior reaches of the hypostome. The leg setae are generally slender, often with fine pilosity at their tips. Single long stout dorsal setae are present on femora III (c. 120  $\mu\text{m}$ ) and IV (c. 145  $\mu\text{m}$ ).

**MALE.** The idiosoma is entirely reticulated and measures 792–828  $\mu\text{m}$  long  $\times$  492–540  $\mu\text{m}$  wide. It is divided dorsally by a median transverse suture (Fig. 58A). The podonotal region

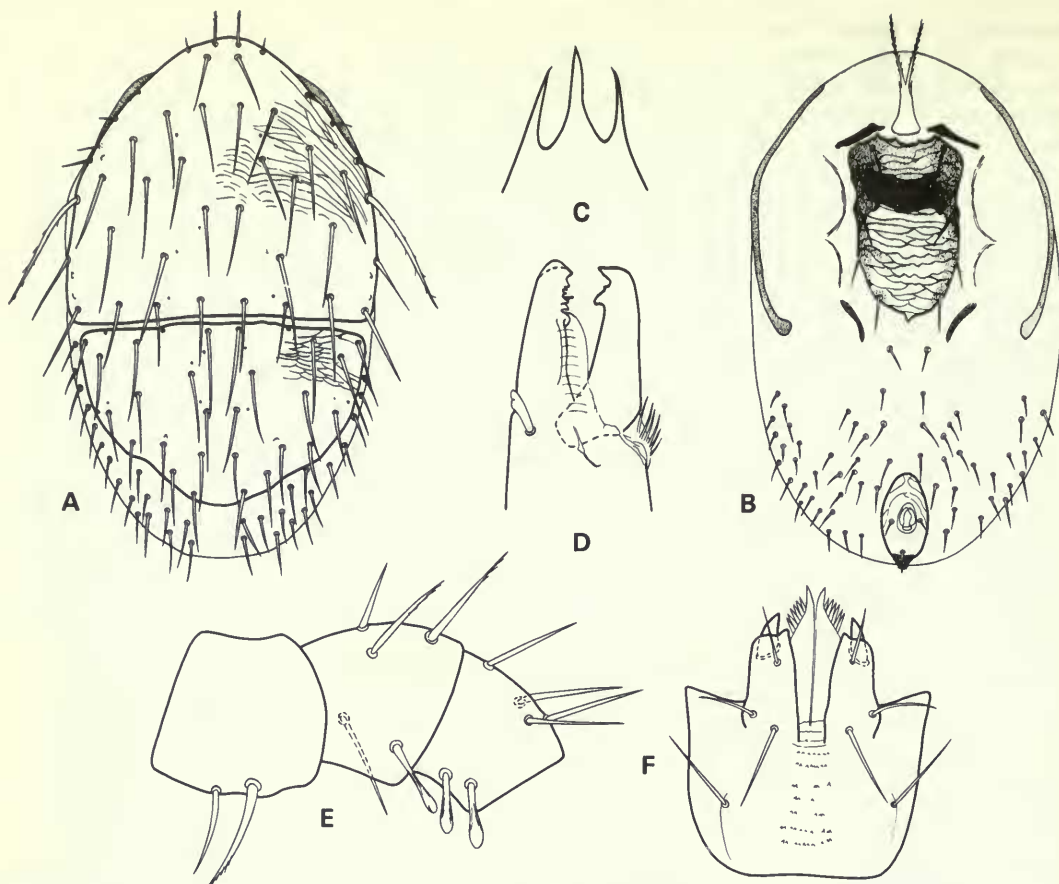


Fig. 57 *Poecilochirus austroasiaticus* Vitzthum, deutonymph – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

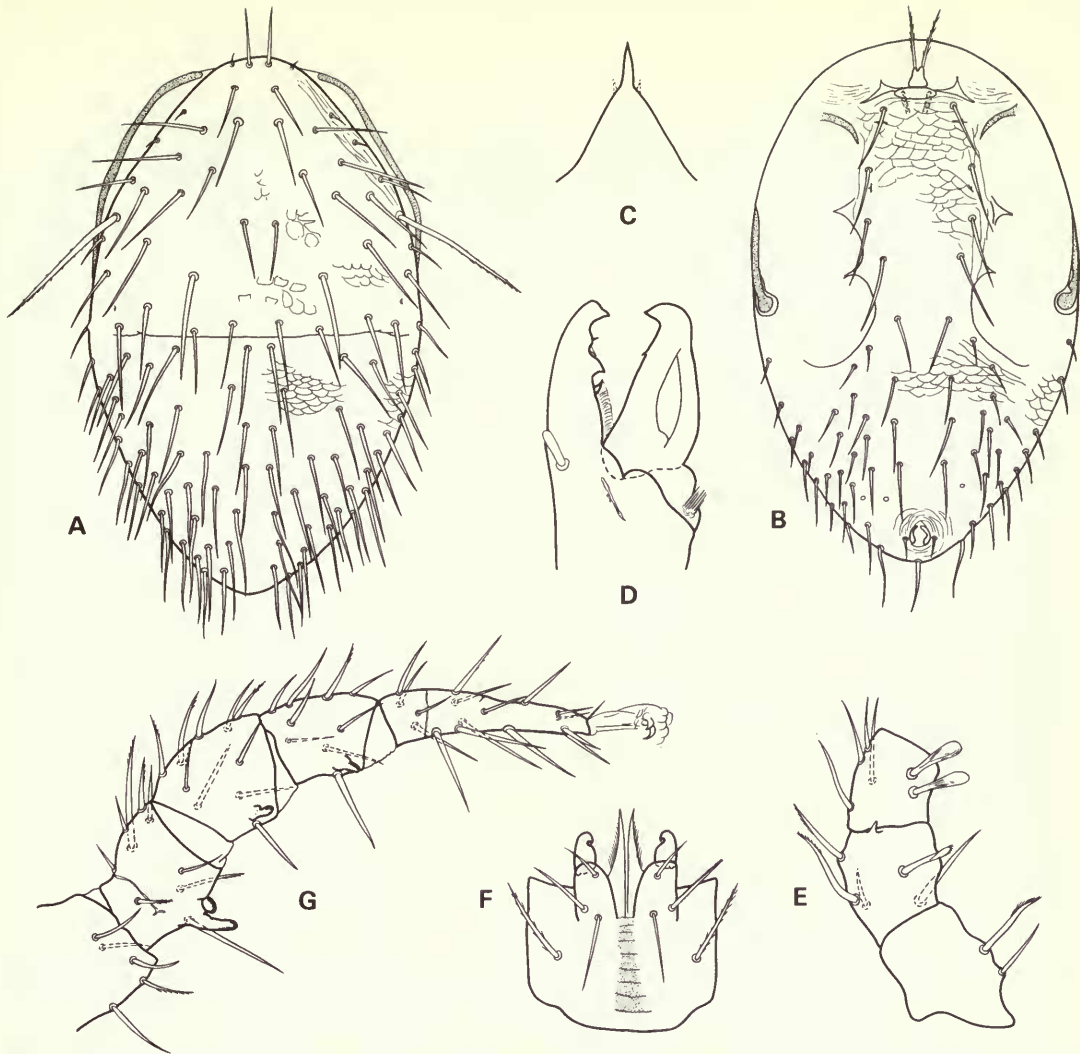
bears 22 pairs of setae whose arrangement and type are as in the deutonymph, with the addition of *r4* which are situated on the shield. The opisthonotal region also bears similar setae to the deutonymph, except that the posterior setae are longer than those on the membrane in that instar.

The tritosternum has a short narrow base and pilose laciniae (Fig. 58B). The venter is entirely reticulated and most setae are relatively long and slender. The postanal seta is more than twice the length of the paranals and is much stouter. The peritreme extends to coxa I.

The tectum comprises a tapering flat process with a single pointed tip which may be flanked by a pair of smaller points (Fig. 58C). The chelicera is shown in figure 58D: the fixed digit is without a membranous process at the tip. The chaetotaxy of the palp trochanter, femur and genu is shown in figure 58E. The three anterolateral setae on the femur and genu are alike. The venter of the gnathosoma is shown in figure 58F. The corniculi are swollen and strongly hooked distally, whilst the palpcoxal setae are stout and pilose. There are no markedly stout or long setae on legs I, III and IV. Leg II is shown in detail in figure 58G.

**FEMALE.** The podonotal shield (480–528  $\mu\text{m}$  long  $\times$  600–648  $\mu\text{m}$  wide) is well sclerotized, granular, entirely reticulated and partly fused with the opisthonotal shield (Fig. 59A). It bears 21 pairs of setae which are generally shorter than in the male and deutonymph. Most are finely pilose at their tips, and *s1*, and sometimes *s2*, may be off the shield. Some specimens have an additional unpaired seta between *s5* and *s6*, this is shown dotted in the figure. The opisthonotal shield is of the same structure as the podonotal and measures





**Fig. 58** *Poecilochirus austroasiaticus* Vitzthum, male – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma; G leg II.

516–552  $\mu\text{m}$  long  $\times$  720–804  $\mu\text{m}$  wide. It bears approximately 40 pairs of setae similar to those on the podonotal shield. As in figure 59A, the two shields may be partly fused.

The tritosternum has a narrow base and pilose laciniae. It is flanked by wedge-shaped presternal shields (Fig. 59B). The sternal shield is granular and well reticulated with the centre portion darker. The genital shield is pointed anteriorly, whilst posteriorly it merges with the opisthogastric shield. The latter is irregular in outline and the opisthogastric setae are not all symmetrically placed. The surrounding membrane bears generally shorter setae than those on the shield. The paranal setae are short, the postanal is long. The peritreme extends to coxa I.

The tectum is shown in figure 59C. It comprises a slender central tip flanked by two small prongs. The chelicera is as in figure 59D, the palp trochanter, femur and genu in figure 59E. The venter of the gnathosoma is shown in detail in figure 59F. The internal posterior hypostomatic and palpcoxal setae are the longest and finely pilose, the corniculi are partly concealed by the anterior of the hypostome. The leg setae are generally finer than in *P. carabi*.

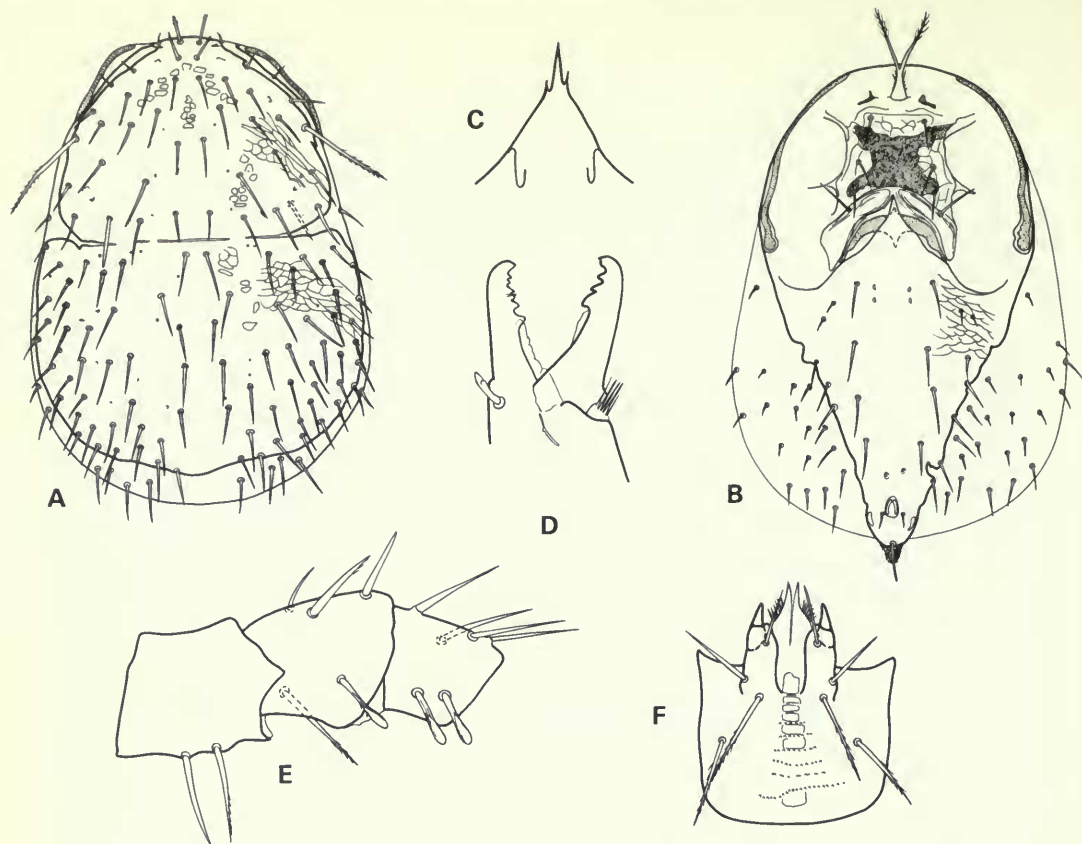


Fig. 59 *Poecilochirus austroasiaticus* Vitzthum, female – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

MATERIAL EXAMINED. 5 samples – several hundred DNN, many ♂♂ and ♀♀.

ENGLAND: Two deutonymphs from a tripe and prepared-meat factory, Torquay, Devon, April 1958; many deutonymphs, males and females in maggots used for fish bait, Surrey, January 1964; many deutonymphs from a glue factory, Bermondsey, London S.E.16, probably around 1940–1945.

SCOTLAND: Five deutonymphs from silphid beetles – one from *Nicrophorus investigator* Zetterstedt and four from *Thanatophilus rugosus* (L.) – Balloch, Dunbartonshire, September 1978, Miss J. E. Christie coll.

DISTRIBUTION. This species is recorded for the first time from the British Isles.

It appears to have been found on the following occasions only: Vitzthum (1930b) based his original description on deutonymphs found on a camel corpse on the Siberia/Manchuria border in June 1927; Willmann (1939a, 1956) recorded deutonymphs from pitfall traps on high moorland in the Sudeten Mountains of Poland and Czechoslovakia; Holzmann (1969) recorded deutonymphs from meat bait near Erlangen, Germany; Karg (1971) recorded this species from pine litter and humus, presumably from Germany, and Davydova (1969, 1976) recorded it from Western Siberia.

*Poecilochirus davydovae* sp. nov.  
(Figs 60A–F; 61A–K)

*Poecilochirus subterraneus* (Müller) sensu Davydova, 1969: 27, 28; 1976: 106. Bregetova *et al.*, 1977: 99, 101.

Davydova (1969 and 1976) recorded *P. subterraneus* (Müller) from Western Siberia and

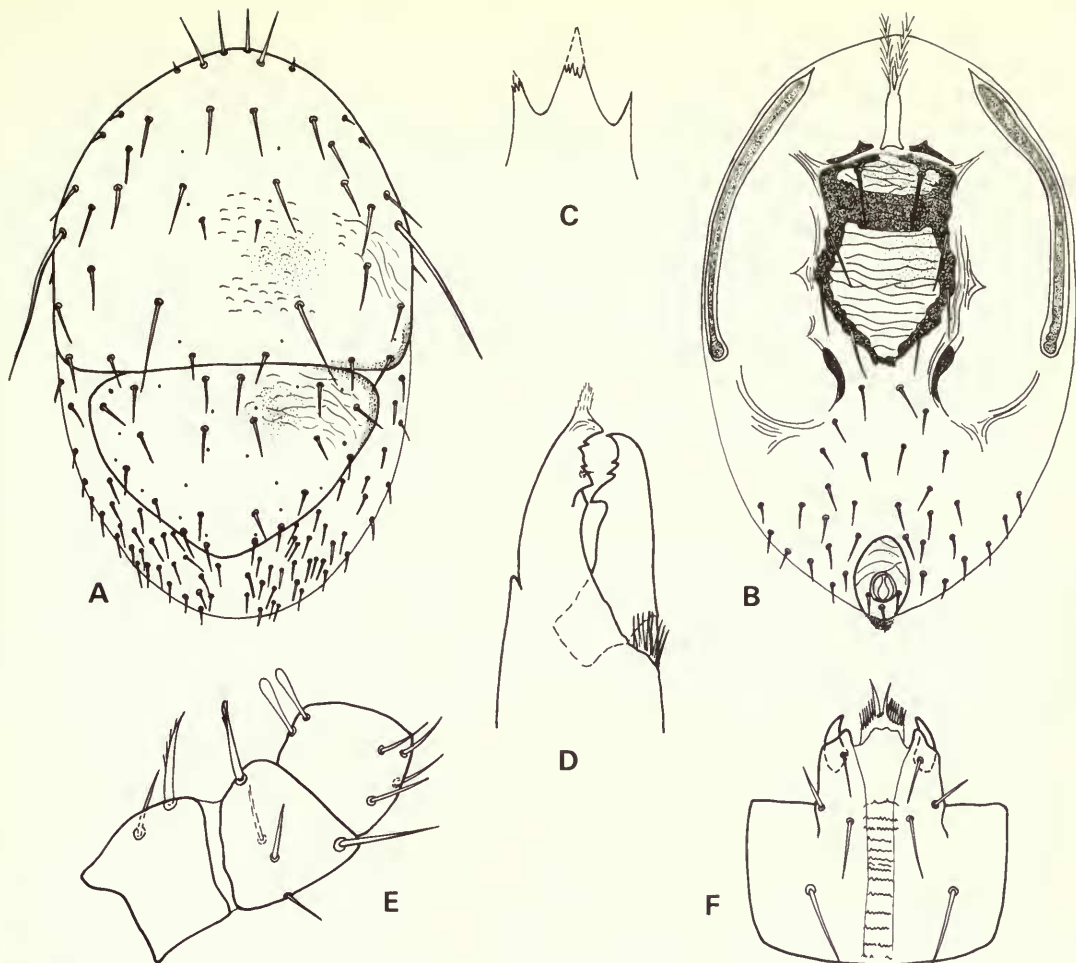


Fig. 60 *Poecilochirus davydovae* sp. n., deutonymph – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

keyed and figured the deutonymph male and female. Although I have not been able to examine her specimens, her figures of the deutonymph are, I feel, clearly conspecific with specimens that I had considered to be of an undescribed species and are not *subterraneus* of Müller.

**DEUTONYMPH.** The podonotal shield measures 320–330  $\mu\text{m}$  long  $\times$  360–380  $\mu\text{m}$  wide (holotype 330  $\mu\text{m}$   $\times$  380  $\mu\text{m}$ ) and is well sclerotized, granular and completely ornamented with a pattern of broken reticulations (Fig. 60A). It bears 20 pairs of simple setae of which *z1*, *s1* and *s2* are minute (c. 8  $\mu\text{m}$ ) and *j5* are only slightly longer (10–12  $\mu\text{m}$ ). The longest setae are *r3* (c. 160  $\mu\text{m}$ ), which is also the stoutest, and *z5* (c. 100  $\mu\text{m}$ ). The remainder are up to c. 45  $\mu\text{m}$  in length. The opisthonotal shield measures 190–200  $\mu\text{m}$  long  $\times$  300–310  $\mu\text{m}$  wide (holotype 200  $\mu\text{m}$   $\times$  310  $\mu\text{m}$ ), fits closely behind the podonotal, and is of similar texture. It bears ten pairs of simple setae in the specimen figured, but in some specimens one pair, *Z4*, are absent. All are c. 28  $\mu\text{m}$  or less in length. The setae on the posterior membrane are slightly shorter, being around 20  $\mu\text{m}$ .

The tritosternum has a narrow base and pilose laciniae. It is flanked by granular elongate presternal shields (Fig. 60B). The sternal shield measures from 200–220  $\mu\text{m}$  in length (holotype 210  $\mu\text{m}$ ), is broad, transversely reticulated, and has a broad darkly sclerotized band between setae I and II which extends posteriorly as a continuous narrow border and curves



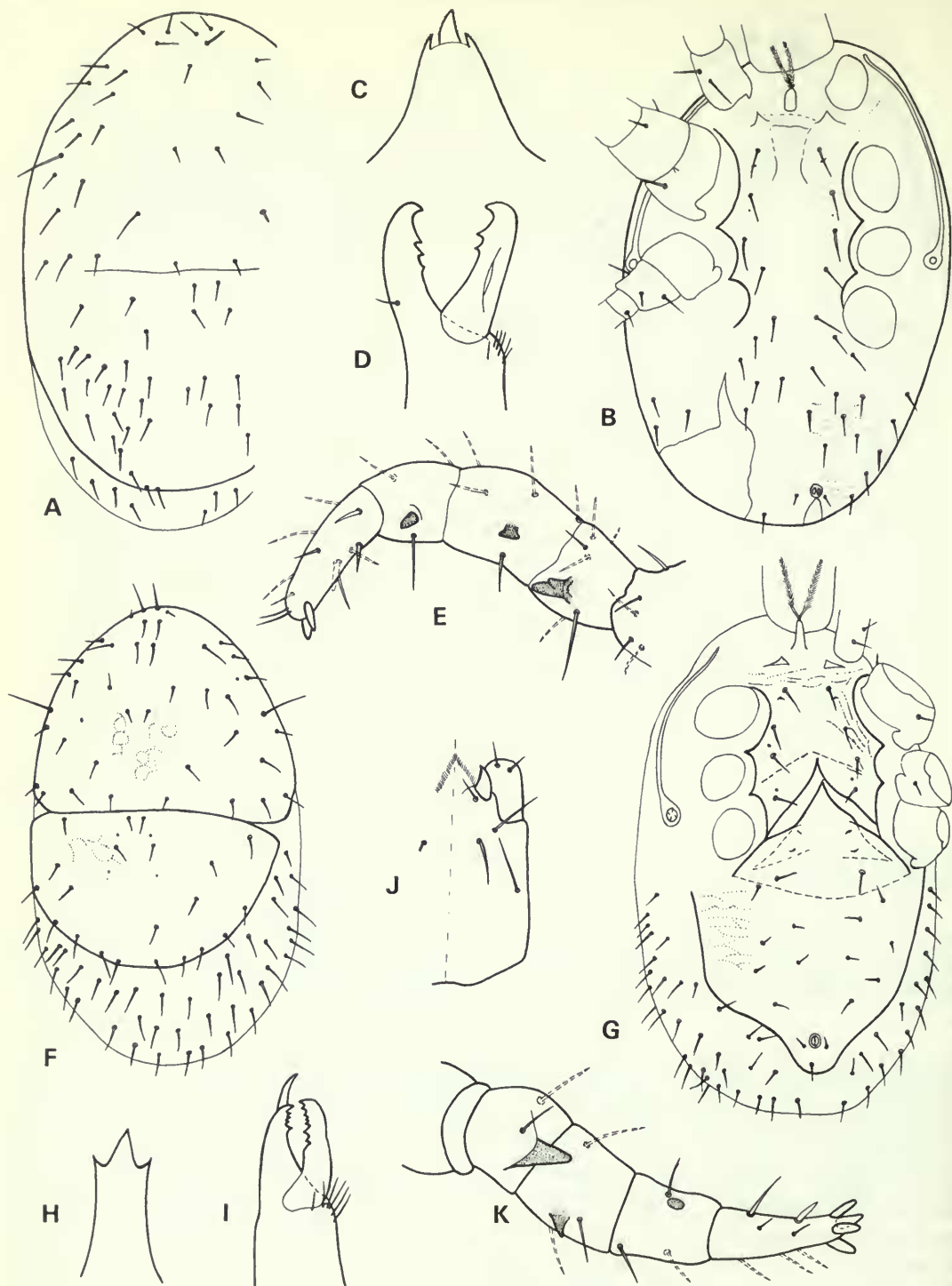


Fig. 61 *Poecilochirus davydovae* sp. n., male - A - dorsum; B venter; C tectum; D chelicera; E leg II; female - F dorsum; G venter; H tectum; I chelicera; J venter of gnathosoma; K leg II. All after Davydova, 1976.

anteriorly around setae I. The sternal setae are strong and slender. The endopodal shields may also be similarly heavily sclerotized, especially at coxae IV. The opisthogastric setae are simple and do not reach the bases of the next in line. The anal shield is elliptical, reticulated and finely granular, the three setae are simple. The peritreme extends to coxa I.

The tectum comprises a long flat process which distally is formed into a broad central prong flanked by a pair of shorter pointed prongs (Fig. 60C). The chelicera is shown in figure 60D. The membranous process at the tip of the fixed digit is sometimes short or weakly developed. The chaetotaxy of the palp trochanter, femur and genu (Fig. 60E) is similar to *P. subterraneus*. The venter of the gnathosoma is as in figure 60F: the corniculi are largely hidden by the hypostome. The leg setae are strong and simple and each leg bears a number of long erect dorsal setae, mainly on the femur, genu, tibia and tarsus as follows: leg I – femur 2, genu 1, tibia 1, tarsus 1; leg II – f. 3, g. 2, ti. 1, ta. 1; leg III – f. 1, g. 1, ti. 1, ta. 0; leg IV – f. 1 (the longest, c. 110  $\mu\text{m}$ ), g. 0, ti. 1, ta. 0.

**MALE AND FEMALE.** Figures 61A–E of the male and 61F–K of the female are based on Davydova (1976). The idiosoma of the male measures 640–678  $\mu\text{m}$  long  $\times$  400–436  $\mu\text{m}$  wide, and the female 778–850  $\mu\text{m}$  long  $\times$  318–332  $\mu\text{m}$  wide.

**MATERIAL EXAMINED.** 4 samples – 21 DNN.

**ENGLAND:** The first sample comprising the holotype (BMNH Reg. No. 1978. 11.9.1) and eight paratypes (1978.11.9.2–6); the second sample comprising four paratypes (1978.11.9.7–9), both from several specimens of *Nicrophorus vespilloides* Herbst (Silphidae), New Forest, Hampshire, 1971, coll. B. J. MacNulty; and two samples of paratypes from silphid beetles, Balloch, Dunbartonshire, September, 1978, coll. Miss J. E. Christie, which comprise six deutonymphs from *Nicrophorus vespilloides* and two deutonymphs from *Thanatophilus rugosus*.

***Poecilochirus subterraneus* (Müller)**  
(Fig. 62A–F)

*Porrhostaspis subterranea* Müller, 1860: 176.

*Parasitus subterraneus*: Oudemans, 1902b: 31.

*Poecilochirus subterraneus*: Berlese, 1904b: 280. Cooreman, 1943: 17. Bregetova, 1956: 62. Micherdzinski, 1969: 664. Holzmann, 1969: 7. Karg, 1971: 419. Non Davydova, 1969: 27, 28; 1976: 106 = *P. davydovae* p. 358.

**DEUTONYMPH.** The podonotal shield (336–360  $\mu\text{m}$  long  $\times$  372–384  $\mu\text{m}$  wide) tapers behind setae *r3* and is well sclerotized, granular and completely ornamented with a pattern of broken reticulations (Fig. 62A). It bears 20 pairs of setae of which *z1*, *s1* and *s2* are minute (c. 8  $\mu\text{m}$ ). The remaining setae are of varying lengths, stout, often sinuous, with *z5* (c. 142  $\mu\text{m}$ ) and *r3* (c. 200  $\mu\text{m}$ ) the longest. The opisthonotal shield (204–240  $\mu\text{m}$  long  $\times$  276–312  $\mu\text{m}$  wide) fits closely to the posterior taper of the podonotal and is similarly granular, but the reticulations are more elongate. It bears 11 pairs of stout setae which are shorter than those of the podonotal shield and of more even length. The posterior membrane bears shorter setae again.

The tritosternum has a narrow base and pilose laciniae. It is flanked by dark elongate presternal shields. The sternal shield (240–255  $\mu\text{m}$  long) is broad, transversely reticulated and has a broad darkly sclerotized transverse band between setae I and II which extends posteriorly as a continuous narrow border and curves anteriorly around setae I (Fig. 62B). The sternal setae are strong and slender. The endopodal shields may also be similarly sclerotized, especially at coxae IV. The opisthogastric setae are strong, slender, and longest in the midventral region where they generally overlap the bases of the next in line. The anal shield is elliptical, reticulated, granular, and the three setae are simple. The peritreme extends to coxa I.

The tectum comprises a long broad process which is forked anteriorly into a central broad prong, which may itself be forked or simple, flanked by short lateral prongs (Fig. 62C). The

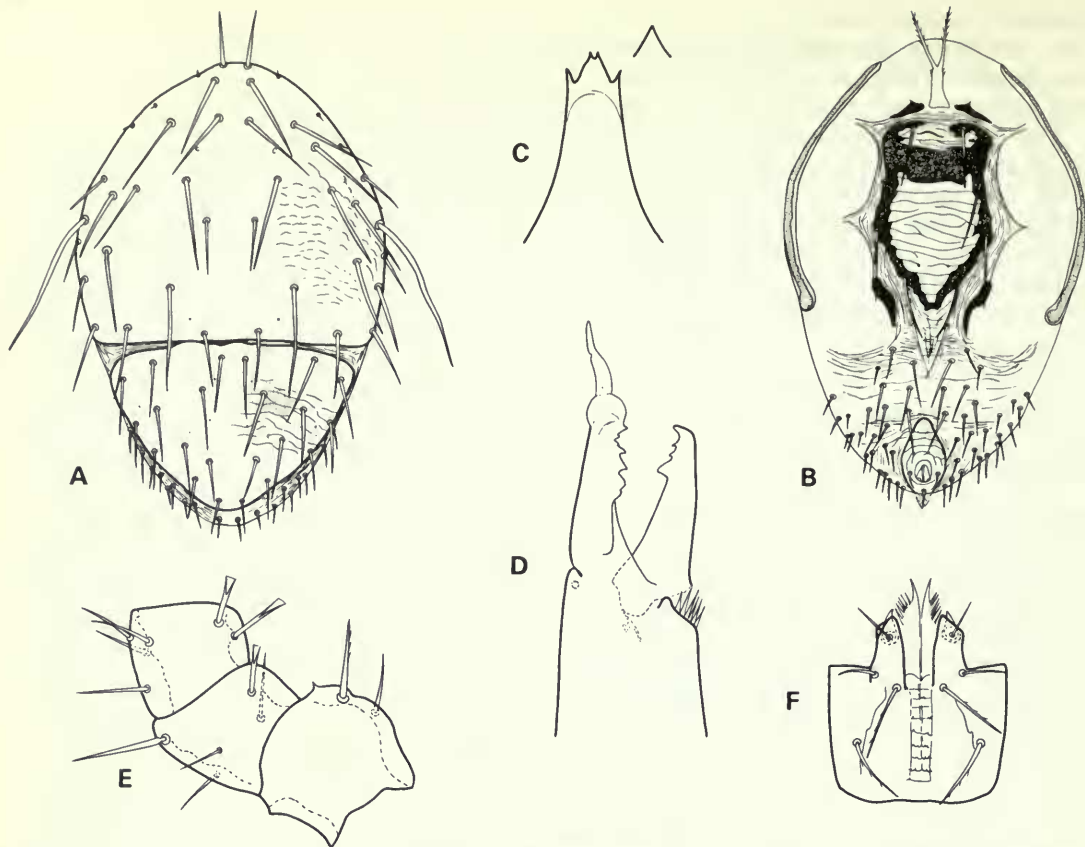


Fig. 62 *Poecilochirus subterraneus* (Müller), deutonymph – A dorsum; B venter; C tectum; D chelicera; E palp trochanter, femur and genu; F venter of gnathosoma.

chelicera is shown in figure 62D. The membranous process at the tip of the fixed digit may be broken off. The chaetotaxy of the palp trochanter, femur and genu is in figure 62E. The anterolateral setae on the femur and genu are alike, being spatulate distally and truncate. The distal dorsal seta on the femur is lancelike. The venter of the gnathosoma is shown in figure 62F. The corniculi are largely hidden by the hypostome. All leg setae are strong, appear simple, and each leg bears a number of long erect dorsal setae, mainly on the femur, genu, tibia and tarsus, as follows: leg I – femur 2, genu 1, tibia 1, tarsus 1; leg II – f. 3, g. 2, ti. 1, ta. 1; leg III – f. 1, g. 1, ti. 1, ta. 0; leg IV – f. 1 (the longest, *c.* 190  $\mu$ m), g. 0, ti. 1, ta. 0.

MALE AND FEMALE. So far the adults of this species have not been found.

Holzmann (1969) has figured the larva.

MATERIAL EXAMINED. 45 samples – *c.* 240 DNN.

ENGLAND: Cornwall, Hampshire, Surrey, Buckinghamshire, Bedfordshire, Suffolk, Norfolk, Derbyshire, Cheshire, Lancashire, Yorkshire.

WALES: Pembrokeshire (Skokholm, Skomer).

SCOTLAND: West Lothian, Dunbartonshire.

IRELAND: No locality given, but from the same collection as some material noted under *Poecilochirus carabi* (p. 350)

The deutonymphs are found mainly on beetles of the widespread genus *Nicrophorus* (Silphidae). Of the forty-five samples examined only two were from other beetles, *Oiceoptoma thoracicum* (L.) (Silphidae) and *Aphodius rufipes* (L.) (Scarabaeidae), whilst one, a single deutonymph, was from leaf litter. Almost nothing is known of the development



or biology of this species, although Holzmänn (1969) figures the larva, and it is possible that occurrences on beetles of genera other than *Nicrophorus* are purely accidental (see also Cooreman, 1943).

**DISTRIBUTION.** This species has only been recorded from the British Isles by Springett (1968) from the Farne Islands, Northumberland, but it would appear from the material examined to be widely distributed.

It is recorded from Holland (Oudemans, 1902*b*, 1902*c*), Belgium (Cooreman, 1943), Germany (Oudemans, 1903*a*, Holzmänn, 1969), Czechoslovakia (Müller, 1860), and the U.S.S.R. (Bregetova, 1956, Vysockaja & Bregetova, 1957). The record of this species from Western Siberia, given by Davydova (1969, 1976) is referable to *Poecilochirus davydovae* sp. nov. (p. 358).

#### Genus *TRACHYGAMASUS* Berlese

*Trachygamasus* Berlese, 1904. *Redia* 1: 235; 1906. *Redia* 3: 116.

*Saprogamasus* Willmann, 1949. *Veröff. Mus. nat.-Völker-Handelsk. Bremen* A1: 136.

*Willmanniella* Götz, 1969. *Acarologie* 13: 24.

**TYPE SPECIES.** *Gamasus pusillus* Berlese, 1892*b*.

Dorsal shield of male entire, with transverse suture; female and deutonymph with separate podonotal and opisthonotal shields. Setae *z5* of dorsal hexagon differing in form from setae *j5* and *j6*. Tritosternum of male absent, of female and deutonymph normal, biramous. Metasternal shields of female either fused with the sternal shield or separated, in part or completely, by a transverse suture. Genital shield subtriangular. Opisthogastric shield of adults with normally not more than six pairs of setae. Setae *al* of palp femur and *al*<sub>1</sub> and *al*<sub>2</sub> of palp genu spatulate. Male chelicerae symmetrical. Corniculi short, entire. Legs of male, female and deutonymph without spurs. Pulvilli of legs II–IV with lateral lobes acuminate.

So far this genus is known only in the nymphal and adult stages. These are readily separated from the other parasitid genera by the presence of slender pointed lobes to the pulvilli of legs II–IV, whilst additionally, in the female, the junction between the sternal and metasternal shields is transverse (it may be very indistinct) and not oblique.

Nine species have been described, namely *Gamasus pusillus* Berlese, 1892*b* (DN, ♂, ♀), from Italy, *?Trachygamasus ohlini* Trägårdh, 1907 (?PN), from the Falkland Islands, *Saprogamasus ambulacralis* Willmann, 1949*b* (♂, ♀), from Germany, *Trachygamasus macfarlanei* Costa, 1962 (DN (not described), ♀), from Israel, *Saprogamasus gracilis* Karg, 1965 (PN, DN, ♂, ♀), from Germany, *Trachygamasus minor* Holzmänn, 1969 (♂, ♀), from Germany, *Willmanniella fallax* Götz, 1969 (♀), also from Germany, *Trachygamasus medianus* Tichomirov, 1977, in Bregetova et al. (♀), from the southern U.S.S.R., and *Trachygamasus triangulus* Karg, 1978 (♀), from Chile.

Up till now there have been no records of *Trachygamasus* from the British Isles, but during the course of the present work six samples—five from Britain and one from Ireland—were examined which comprised 39 deutonymphs, one male and eleven females. All appear to belong to one species which by virtue of the measurements of the adults I am identifying as *ambulacralis* (Willmann). More recently, however, Professor G. O. Evans has sent me six deutonymphs and one female from two collecting sites in Ireland. These are all smaller than the specimens previously examined and were identified by Evans (*in litt.*) as *gracilis* (Karg), with which I agree. The adults only of *pusillus*, *ambulacralis* and *minor* are figured by Holzmänn (1969) and *fallax* by Götz (1969), whilst Karg (1971) synonymizes *minor* with *gracilis*. Comparison of the British and Irish specimens with the published figures and descriptions have so far only established that two forms are represented and these are separable only on size: those which I am referring to *ambulacralis* are all larger than those referred to *gracilis*. The variations in setal lengths, form of the tectum and degree of sclerotization of dorsal and ventral shields are criteria that previous authors have emphasized as diagnostic features, but all variations occur within one sample. Professor M. Costa (pers. comm.) has pointed out that Karg's 1965 and 1971 papers contain

contradictions, or at least changes of opinion, which tend to render more unstable the distinctions between species. Therefore, until more samples containing all post-embryonic developmental stages are collected I am not prepared to pronounce judgment on the validity of the known species or to be more committal on the identity of the few specimens so far recorded from the British Isles.

*Trachygamasus ambulacralis* (Willmann)  
(Figs. 63A–I; 64A–I)

*Saprogamasus ambulacralis* Willmann, 1949b: 137. Micherdzinski, 1969: 612. Bregetova *et al.*, 1977: 97, 98.

*Trachygamasus ambulacralis*: Karg, 1971: 420.

**DEUTONYMPH.** The weakly sclerotized dorsal shields are finely reticulated (Fig. 63A). The podonotal shield (264–283  $\mu\text{m}$  long  $\times$  264–316  $\mu\text{m}$  wide) bears 20 pairs of setae, *s*<sub>2</sub> being generally situated off the shield. With the exception of setae *r*<sub>3</sub> and *z*<sub>5</sub>, which are stouter and longer than the remainder and are finely pilose distally, all setae are simple. The opisthonotal shield (162–210  $\mu\text{m}$  long  $\times$  228–260  $\mu\text{m}$  wide) bears 12–13 pairs of setae, the pair shown dotted in the figure being frequently situated on the membrane adjacent to the shield. Setae *S*<sub>4</sub> are stouter than the remainder and are finely pilose distally. The posterior interscutal membrane bears about 16 pairs of slender simple setae.

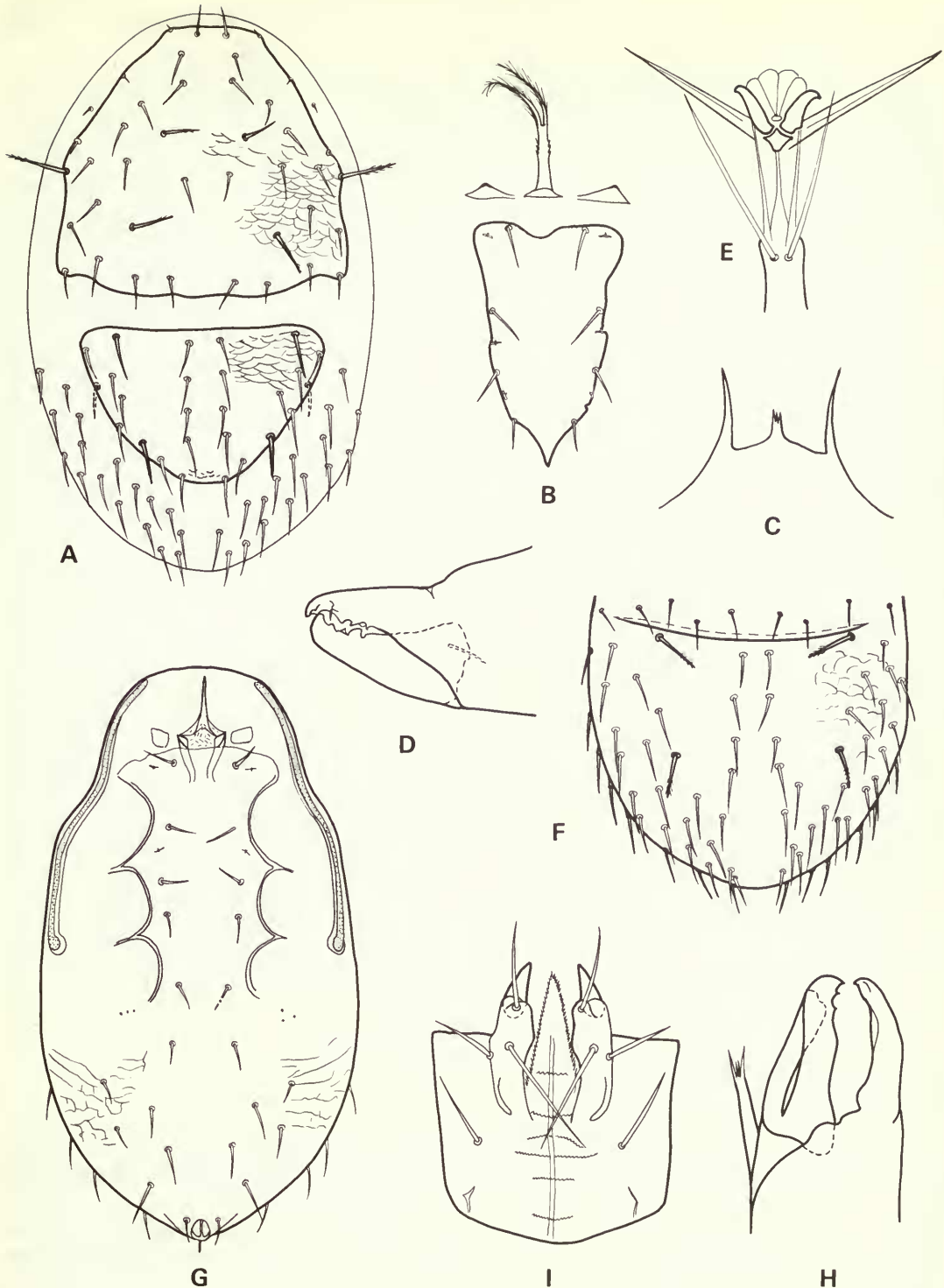
The tritosternum has a narrow base and pilose laciniae. It is flanked by a pair of triangular presternal shields (Fig. 63B). The sternal shield (c. 168  $\mu\text{m}$  long), and the anal shield are very weakly sclerotized, the former is devoid of ornamentation and bears four pairs of fine simple setae, the latter bears the normal three setae all of which are simple. The stigma is situated adjacent to the posterior margin of coxa III and the finely granular peritreme extends anteriorly to the level of coxa I. The membrane posterior to the sternal shield bears approximately 12 pairs of fine slender simple setae. The metapodal plates are barely discernible.

The tectum most frequently has the centre prong broken off (Fig. 63C), but when entire it is similar to that of the female (Fig. 64E). The chelicera is shown in figure 63D. The chaetotaxy of the palp trochanter, femur and genu is as in the adults (Fig. 64G). The corniculi and gnathosomal setae are as in the female (Fig. 64H), whilst the hypognathal denticles are indistinct, about ten rows being present. Legs I–III bear fine simple setae, but leg IV, on which the setae are somewhat stouter, has in addition an erect pilose dorsal seta proximally which measures 85  $\mu\text{m}$  in length. Pulvilli II–IV have the lateral lobes acute (Fig. 63E).

**MALE.** The dorsal shield (630  $\mu\text{m}$  long  $\times$  340–361  $\mu\text{m}$  wide) is entire but with a transverse median suture extending almost to the margins. It is reticulated except in the region between setae *z*<sub>5</sub> and *J*<sub>5</sub> which is almost devoid of ornamentation. The podonotal region bears 21 pairs of setae of which *j*<sub>4</sub>, *r*<sub>3</sub> and *z*<sub>5</sub> are stout and plumose distally as in the female (Fig. 64A). The opisthonotal region (Fig. 63F) bears from 32–38 pairs of setae of which *Z*<sub>1</sub> and *Z*<sub>3</sub> are stout and pilose distally, the remainder, in both regions, being slender and simple.

The tritosternum is absent. The genital lamina protrudes anteriorly from the holovenral shield and is flanked by a pair of squarish presternal shields (Fig. 63G). The five simple pairs of sternogenital setae are fine and slender, as are the six pairs of opisthogastric setae and the three anal setae. The stigma is situated opposite the posterior margin of coxa III and the finely granular peritreme extends to beyond coxa I.

The tectum is as in the female (Fig. 64E). The chelicera is shown in figure 63H. The chaetotaxy of the palp trochanter, femur and genu is as in the female (Fig. 64G). The corniculi are simple (Fig. 63I), but are, with the anterior hypostomatic setae, raised on stalk-like protuberances of the gnathosoma. The hypognathal denticles are not distinct, only six rows being readily discernible. All setae on the legs are simple and relatively slender. The males of *Trachygamasus* are unique in the Parasitidae in that there are no spurs or



**Fig. 63** *Trachygamasus ambulacralis* (Willmann), **deutonymph** – A dorsum; B sternal shield and tritosternum; C tectum; D chelicera; E pulvillus of legs II–IV; **male** – F opisthonotal region; G venter; H chelicera; I venter of gnathosoma.



hypertrophied setae on leg II. The pulvilli of legs II–IV have the lateral lobes acute as in the female (Fig. 64I).

**FEMALE.** The podonotal shield (350–430  $\mu\text{m}$  long  $\times$  350–490  $\mu\text{m}$  wide) is extensively reticulated and bears 21 pairs of setae of which *j*<sub>4</sub>, *r*<sub>3</sub> and *z*<sub>5</sub> are stout and pilose distally (Fig. 64A). The posterior margin is convex medially. The opisthonotal shield (300–470  $\mu\text{m}$  long  $\times$  320–460  $\mu\text{m}$  wide) bears a maximum of 18 and a minimum of 15 pairs of setae, several from the anterolateral margin being frequently situated on the adjacent membrane (Fig. 64B). Setae *Z*<sub>1</sub> and *Z*<sub>3</sub> are stout and pilose distally, the remainder being slender and simple. The laterally reticulate shield is concave anteromedially. The posterior interscutal membrane bears a dozen or more pairs of simple setae.

The tritosternum, which is typically bilacinate, is flanked by small trapezoidal presternal shields (Fig. 64C). The granular sternal and metasternal shields, shown in detail in figure 64D, are separated by a transverse suture. Sternal setae I and IV are fine and slender, whilst II and III are shorter and stout. The genital shield is pointed anteriorly, but the lateral margins are irregularly formed. The genital setae are simple. The opisthogastric shield bears six pairs of simple setae and the anal setae are short and simple. One pair of setae on the membrane adjacent to the anus is pilose distally. The stigma is situated adjacent to the posterior margin of coxa III and the granular peritreme extends to beyond coxa I (Fig. 64B).

The tectum (Fig. 64E) is three-pronged with the central prong, which is frequently broken off, trifid end finelypectinate distally. The lateral prongs are also slightly pilose. The chelicerae (Fig. 64F), which are similar to those of the deutonymph, bear three symmetrical teeth on the movable digits, but less clearly defined teeth on the fixed digits. The palp trochanter, femur and genu are shown in figure 64G. The corniculi are plain (Fig. 64H), the gnathosomal setae simple, and from ten to twelve rows of hypognathal denticles are discernible. All setae on the legs are simple. The ambulacra of legs II–IV have the lateral lobes of the pulvilli acute (Fig. 64I).

**MATERIAL EXAMINED.** 6 samples – 40 DNN, 4 ♂♂, 12 ♀♀.

**ENGLAND:** From sewage filter-beds, Birmingham, 1966, 1975; from mosses, rushes and damp grasses, Startops End Reservoir, Buckinghamshire/Hertfordshire borders, 1 February 1964; moss and humus, Bath, Kennet and Avon Canal, Somerset, 10 March 1962.

**SCOTLAND:** From nest of water vole *Arvicola terrestris* (L.), near Aberdeen, 3 December 1965.

**IRELAND:** From seaweed, Bell Harbour, Co. Clare, September – October 1961.

**DISTRIBUTION.** Previously known only from Germany (Willmann, 1949*b*, Holzmann, 1969, Karg, 1971) where it has been scantily recorded on agricultural land from rotting vegetables, especially root crops, and from damp meadows and woodland.

### *Trachygamasus gracilis* (Karg)

*Saprogamasus gracilis* Karg, 1965: 300. Bregetova *et al.*, 1977: 98.

*Trachygamasus gracilis*: Karg, 1971: 420.

*Trachygamasus minor* Holzmann, 1969: 23. Karg, 1971: 420.

As stated above, I can see no constant differences, apart from size, between the species identified here as *Trachygamasus ambulacralis* (Willmann) and *T. gracilis* (Karg). The following are the main measurements of the *gracilis* specimens:

**DEUTONYMPH.** Podonotal shield 212–240  $\mu\text{m}$  long  $\times$  200–235  $\mu\text{m}$  wide, opisthonotal shield 125–150  $\mu\text{m}$  long  $\times$  167–202  $\mu\text{m}$  wide, sternal shield 137–155  $\mu\text{m}$  long. The erect dorsal seta on tarsus IV is 57–60  $\mu\text{m}$  long.

**MALE.** Not collected.

**FEMALE.** Podonotal shield 250  $\mu\text{m}$  long  $\times$  262  $\mu\text{m}$  wide, opisthonotal shield 225  $\mu\text{m}$  long  $\times$  250  $\mu\text{m}$  wide.

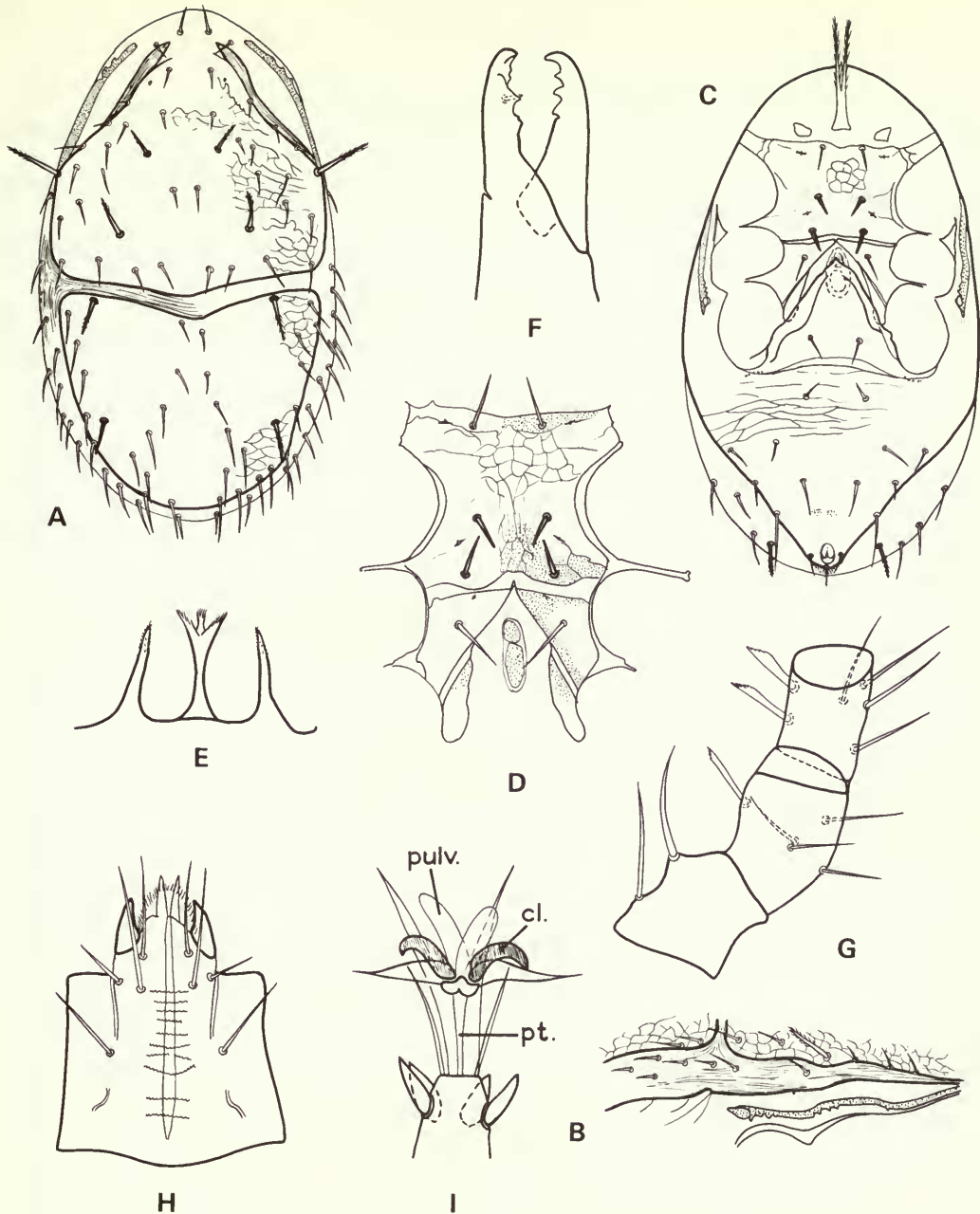


Fig. 64 *Trachygamasus ambulacralis* (Willmann), female—A dorsum; B lateral interscutal region; C venter; D sternogenital region; E tectum; F chelicera; G palp trochanter, femur and genu; H venter of gnathosoma; I ambulacrum of legs II–IV. Abbreviations in text, p. 246.

MATERIAL EXAMINED. 2 samples – 6 DNN, 1♀.

IRELAND: Meath; Grange, and Kildare; Celbridge, both in grassland.

DISTRIBUTION. Previously known only from Germany (Karg, 1965, 1971 and Holzmann, 1969) where it is scantily recorded from cucumber soil in greenhouses and from cowdung.

### Taxonomic summary

(a) *Poecilochirus davydovae* sp. nov. is described.

(b) The following new synonymy is presented:

*Eugamasus spinosustarsis* Schweizer, 1961, is a synonym of *Eugamasus magnus* (Kramer, 1876).

*Parasitus eta* Oudemans & Voigts, 1904, is a synonym of *Parasitus fimetorum* (Berlese, 1904).

*Parasitus anglicus*, *bombophilus* and *numismaticus*, all Vitzthum, 1930, are synonyms of *Parasitellus talparum* (Oudemans, 1913).

*Parasitus crinitosimilis* and *dubiosus*, both Vitzthum, 1930, are synonyms of *Parasitellus crinitus* (Oudemans, 1903).

*Parasitus hibernicus* Turk & Turk, 1952, is a synonym of *Parasitus fimetorum* (Berlese, 1904).

*Parasitus lunarisimilis* Schweizer, 1961, is a synonym of *Gamasodes spiniger* (Trägårdh, 1910).

*Poecilochirus necrophori* Vitzthum, 1930, is a synonym of *Poecilochirus carabi* (G. & R. Canestrini, 1882).

*Poecilochirus nordi* Davydova, 1969, is a synonym of *Poecilochirus austroasiaticus* Vitzthum, 1930.

(c) The following new combinations are proposed.

*Parasitellus crinitus* (Oudemans, 1903)

*Parasitellus ignotus* (Vitzthum, 1913)

*Parasitellus talparum* (Oudemans, 1913)

*Vulgarogamasus kraepelini* (Berlese, 1905)

*Vulgarogamasus oudemansi* (Berlese, 1904)

### Species new to the British Isles

*Eugamasus cavernicola* Trägårdh, 1912

*Eugamasus magnus* (Kramer, 1876)

*Gamasodes fimbriatus* Karg, 1971

*Parasitellus crinitus* (Oudemans, 1903)

*Parasitellus ignotus* (Vitzthum, 1930)

*Parasitus beta* Oudemans & Voigts, 1904

*Parasitus copridis* Costa, 1963

*Parasitus evertsi* Oudemans, 1902

*Parasitus hyalinus* (Willmann, 1949)

*Parasitus insignis* (Holzmann, 1969)

*Poecilochirus austroasiaticus* Vitzthum, 1930

*Poecilochirus davydovae* sp. nov.

*Trachygamasus ambulacralis* (Willmann, 1949)

*Trachygamasus gracilis* (Karg, 1971)

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